.EXE

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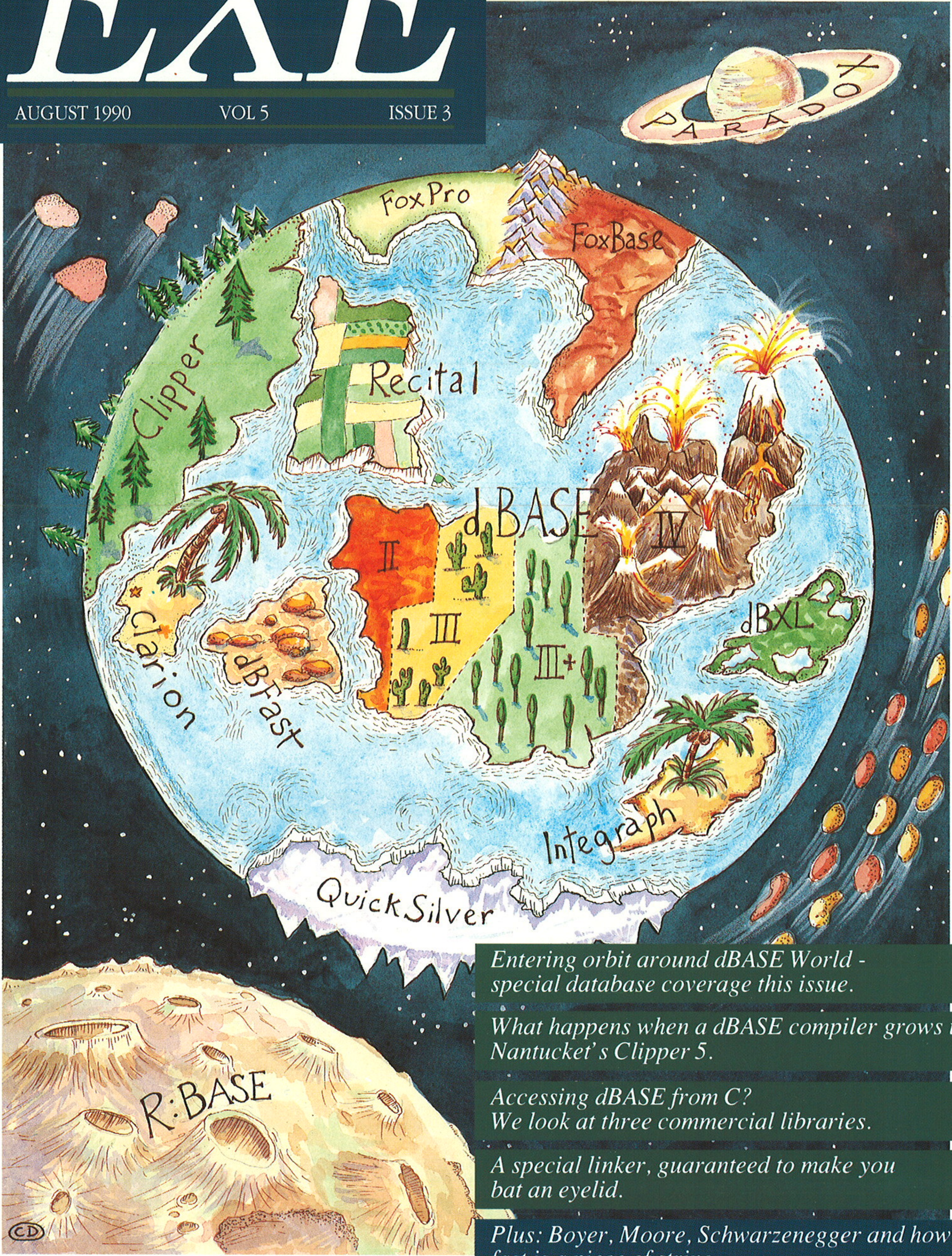
The Software Developers' Magazine



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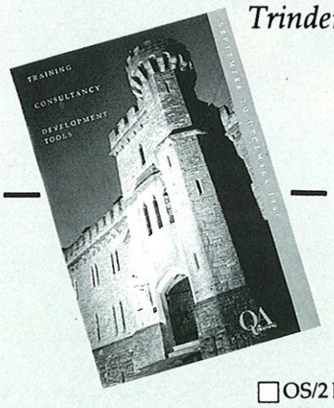

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August 1990

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Pronunciation
The name of .EXE Magazine is pronounced to rhyme with 'not sexy magazine'.

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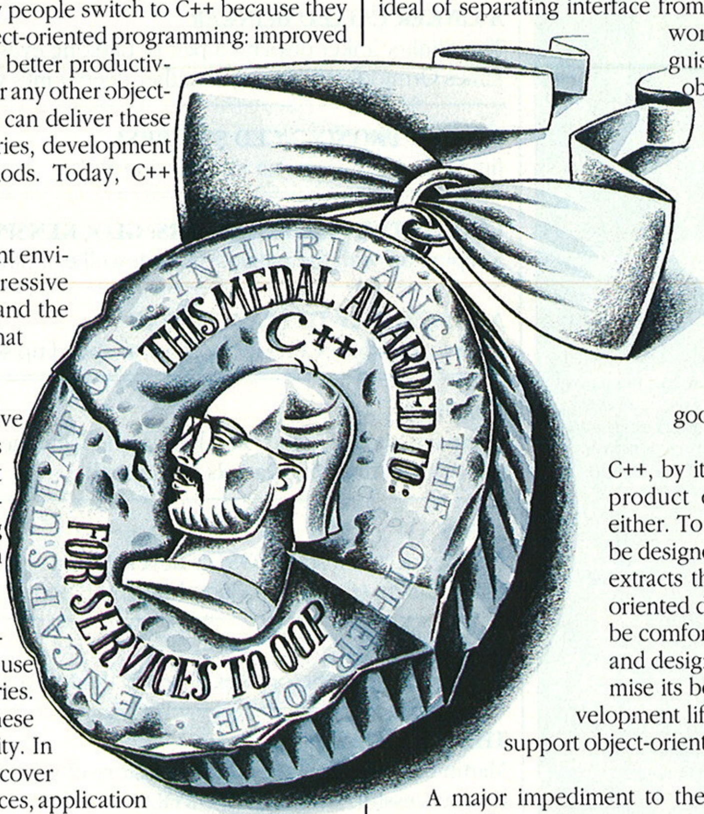
SPECIAL ISSUE - dBASE WORLD

OOP is more than using C++

As the OOP bandwagon moves onwards, developers are increasingly turning to C++ to take advantage of this paridigm. John Daniels doubts the wisdom of this approach.

Thinking of changing to C++? Consider this: during the past year thousands of developers have made the switch and many, perhaps most, are disappointed with the results.

There is nothing wrong with C++ provided you accept it for what it is. A better C. The problem is, many people switch to C++ because they want the benefits claimed for object-oriented programming: improved quality, easier enhancement and better productivity. Unfortunately, neither C++ nor any other object-oriented programming language can deliver these without support from class libraries, development environments and design methods. Today, C++ does not have that support.



The productivity of a development environment depends on the expressive power of a language statement and the time to invent, code and test that statement.

C++ does have more expressive power than C. But, as is always the case, the ability to exploit that power depends upon the richness of the libraries of existing code which we can invoke from primitive statements.

The best way to boost productivity would be to make extensive use of publicly-available class libraries. Today, there aren't many of these and they are often of poor quality. In the main, the libraries available cover three areas: graphical user interfaces, application frameworks and computational abstractions, such as sets, lists, etc. A well-written set of integrated libraries covering all of these areas would go a long way towards improving productivity. At present, the closest we have is a C++ version of Apple's MacApp, the application framework that made ObjectPascal so popular with Macintosh developers. In the UNIX world there is ET++, a public domain library. ET++ is huge, powerful and, ultimately, flawed. For PCs, no integrated application framework is available.

If publicly-available libraries don't have much to offer, we can always look for improved productivity from reuse of our own code. But problems lurk here too. Reuse of code from one project to the next certainly seems feasible, provided time is spent getting it into the correct form. Reuse of code within one project is much harder to achieve, unless the code is being developed and reused by a single person.

The shared reuse of code still being developed is made hard by the primitive state of C++ tools and by the nature of C++ itself. It is a problem of dependencies. C++ class definitions might have public and private sections, but that doesn't mean changes to the private part do not affect users of the class. Far from it. All clients must know, at compile time, the memory size of instances of the class. This means that all client code must be re-compiled whenever data members are added or removed - even if they are private. What happened to the ideal of separating interface from implementation? To make matters worse, current C++ tools can't distinguish between changes that affect the object size and those that don't, thereby causing many unnecessary compilations. And make no mistake, C++ compilation can be slow when large numbers of library classes are included.

In short, productivity depends on class libraries and development environments, not on programming languages. Today, there are a few reasonable C++ libraries but no good environments.

C++, by itself, can't help you with improved product quality and easier enhancement either. To get these benefits the system must be designed in an object-oriented style which extracts the best from the language. Object-oriented design is still in its infancy. It cannot be comfortably integrated with other analysis and design approaches but requires, to maximise its benefits, that the whole software development life-cycle be revised. Few CASE tools support object-oriented development.

A major impediment to the construction of high quality C++ systems is that any C programmer can write correct C++. That certainly doesn't mean they can write good C++. Many organizations like the idea of C++ because they believe that its similarity to C will reduce training costs. Experience suggests that such savings are small. Good software is good because it is based on a sound architectural framework. Designing good frameworks with classes is hard and takes years of practice. People with skills in this area are in short supply.

Object-oriented software development can deliver the touted benefits, but not through a language alone. Don't be misled. C++ might be today's most popular object-oriented programming language but the most productive of object-oriented software developers aren't using it.

John Daniels is a Consultant at Object Designers Ltd, an independent software consultancy specialising in object-oriented technologies. He can be contacted on 0279 755396.

We are looking for contributors to this new column. If you have an opinion or idea that you would like to air here, please contact the Editor at the address given on page 1.

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News

PDQ

PDQ is a library for Microsoft QuickBASIC V4.0 or later and BASIC compiler V6.0 or later. It replaces the default library supplied by Microsoft. Code modules linked to it form executables as small and fast as those produced by C and Pascal (it says here). There is also a facility to produce TSRs. PDQ V2.0 has just been released; it is available direct from its US creators Crescent Software (0101 203 438 5300) priced $129 + $35 shipping.

Doctor DOS

I thought that Digital Research's DR DOS V5.0 was already shipping, but a man dressed up as a stork alerted me to the fact that it was not by coming round to our offices and 'laying' a copy of the just-released package. How amusing. DR DOS is also more expensive than I previously reported - it costs £119.95, from Megatech (081 874 6511).

Code Base upgrade

Code Base V4.2 is the just-released updated version of the Code Base dBASE library, which is reviewed elsewhere in this issue. The library now includes a browse/edit facility, and can be used under MS-DOS, OS/2, UNIX or Windows. The MS-DOS and OS/2 version costs £190 ex VAT, and a 'portability' version is £320. The distributor is the Software Construction Company (0763 244114).

Lahey FORTRAN

Lahey is a US company specialising in FORTRAN. It has a 32-bit MS-DOS compiler called F77L-EM/32, which requires the company's DOS Extender product, called Ergo, in order to work. This compiler has just reached Version 3.0 - new features include an editor and make utility. US prices are $895 for the compiler plus $395 for the Extender. Lahey has also upgraded its small memory model 16-bit 'Personal FORTRAN', which costs US $99. UK distributors are Grey Matter (0364 53499) and System Science (071 833 8222).

Software Users Year Book

The Software Users Year Book is a four volume catalogue of all the commercial software available. Whether you want to find out how many 32-bit LISP compilers are available for your machine, or need to find an accounting and stock control package suitable for a small pharmacy in Basingstoke, you will find it in here. The 1991 edition has just been published, it costs £130 + £5.50 p&p. It is available direct from its publishers: VNU (071 439 4242).

OS/2 V1.3?

Forget OS/2 V2.0, with fully-fledged 80386 support. There is now a very real danger that the next released version of OS/2 will be 16-bit. IBM recently dropped hints about a revised version of OS/2 V1.2, which could get by with about 3 MB of RAM and ditto of disk space. The existing effort requires at least an extra megabyte of each. Other enhancements are to include a better 8514 display driver (5 bits per pixel instead of just two) and the bundling of Adobe's Type Manager, which contains fonts superior to those currently offered, resulting in faster screen handling.

As is traditional, IBM declined to name a date when the product might appear, although it did indicate that work on reducing the memory requirements of the OS was well in hand. With pre-release versions of OS/2 V2.0 already being tested by selected developers, one would imagine that V1.3 must appear within a few months if it is to make any impact.

Don't compare us with Clipper

Force is a dBASE compiler which its distributors, Continuous Technology Ltd, do not want compared with Clipper. In order to foster this spirit of non-comparision, the company has sent me a set of speed benchmarks which compares Force with... Clipper (very favourably, natch).

A telephone call provided enlightenment. Force achieves its high speed and small executables by throwing out the sections of the dBASE language that are slow and bulky to implement; for example macro handling. By the same fix, it also avoids having to worry about memory fragmentation. The designers have instead introduced various C language features, such as a preprocessor and a proper, stack-based calling convention that lets you hook into standard C libraries (although the library supplied with the kit sounds quite reasonable - it is a complete reimplementation of Turbo C's). You can even do TSRs. The flip side of the coin is that your dBASE applications will require significant modification before they can be compiled under Force - for example, Force requires that variables and file structures are all explicitly declared before use. It is this weakness that makes comparison with Clipper specious.

Force costs £695 ex VAT, Continuous Technology Ltd is on 0372 727269.

An APL Interpreter- and change from £10

The I-APL project exists to promote the use of the APL programming language, especially in education. To this end, it has produced an APL interpreter which runs on a range of small machines such as the BBC Master, Research Machines Ltd's Nimbus plus the inevitable PC-compatible; ports to the Mac, Amstrad 8256/8512 and Commodore 64 are in the pipeline. Copies of the interpreter are sold at cost price; sharing with friends is encouraged, although you are not supposed to make use of the software in commercial applications. Not that you are likely to do this: I-APL is built on a 64 KB memory model, and the interpreter leaves only 30 KB for the user.

If you fancy having a go with this unusual language, then a starter kit (PC version on 360 KB disk + a 55 page manual) costs £5.50, including P&P. Cheques should be made payable to I-APL Ltd, and orders sent to 56 The Crescent, Milton, Weston super Mare, Avon BS22 8DU. Enquiries should be directed to Anthony Camacho, 2 Blenheim Rd, St Albans, Herts AL1 4NR.

UNIX - The Legend Evolves

As this issue of .EXE went to press, the UK UNIX systems User Group was holding its Summer 1990 Technical Conference at the Royal Lancaster Hotel in London. This week-long event, which commenced on the 9th July with two days of tutorials, attracted some 420 UNIX devotees. Some very well-known industry luminaries were speakers.

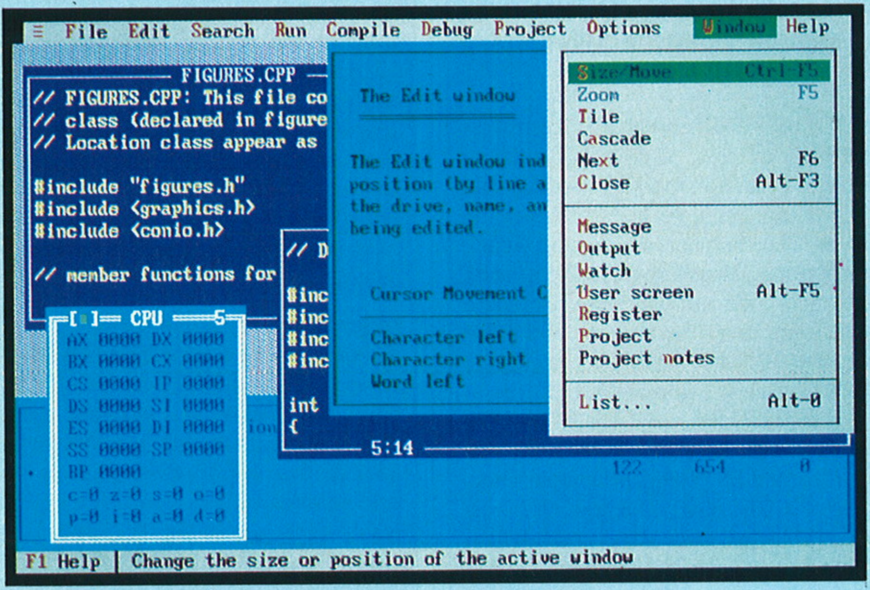
On the first full day of the conference, the sessions covered: Plan 9, a UNIX successor currently under development at AT&T Bell Labs; C (papers presented by Dennis Ritchie and Ken Thompson) and C++ (a passionately argued paper by an ex-Bell Labs staffer, Tom Cargill, who is trying to see Multiple Inheritance removed from the forthcoming ANSI C++ standard); networking and distribution protocols. Later papers covered UNIX internals, advanced graphics and music applications, software productivity (presented by Brian Kernighan) and distributed systems.

Your reporter was intrigued to see several conference attendees wearing T-shirts depicting our hero Bjarne Stroustrup with a large wood screw through his head. We would like to track down the source of these T-shirts - anybody who knows where they come from please contact .EXE's news desk. There's a .EXE T-shirt in it for the first person to produce the information.

For details on the UKUUG call 0763 73039.

Paul G Smith

HotShot



This the story of how I solved one of .EXE's problems; but it might be one of yours as well. When we review software, we often throw in a few screen shots, to give you a better idea of what the package is like. Usually these are text mode screens - editors, debuggers and the like. To get these I have had to send a diskette off to a photographic studio where they took photographs of a PC's monitor. The results were unevenly exposed and, thanks to the curvature of the CRT, never quite in focus.

The crisp, sharp picture of Turbo C++ that you are looking at (or, if you are not, bear in mind that these pages were assembled on Friday 13th) was obtained with a package called HotShot Graphics. HotShot can grab a screen in most common video modes, including text and VGA graphics. There are special modules to handle Windows and OS/2 PM. It has some rather neat editing facilities, so you can doctor the captured screens. But the best part, in the current context, is the facility to convert screens captured in text mode into the bit image format required by laser scanner machines. The photo was produced from a PCX file, but HotShot does about half-a-dozen other common formats. If your manual or brochure does not run to colour printing, HotShot also produces grey-scale images, suitable for importing into Ventura, WordPerfect etc.

HotShot Graphics costs £179.95, and is available from Ctrl Alt Deli (0908 662759). Our picture was produced from a PCX file by Advanced Business Graphics (081 569 9944), which charges £12.50 per slide.

MultiBase

One of the large number of dBASE-related announcements this month concerned MultiBase. This is a MS-DOS based multi-user database which contains its own multi-tasking executive - it is a bit like a copy of Concurrent DOS and a database bundled together. The multi-tasking is done in protected mode, so you will need an AT or better. Up to 30 terminals can be attached via serial ports - a free bundled comms program allows PCs to be set up as dumb terminals - or, if this is not fast enough, an ARCNET version is available at extra cost. The language is near dBASE III+ compatible, supporting many Clipper extensions.

The most obvious drawbacks to MultiBase: the data file format is non-standard, so data has to be converted explicitly to/from dBASE; and you need to distribute a run-time module with your applications, which is licensed at a cool £499 a shot. The development system itself costs £599, add £100 for ARCNET support. The UK distributor is Rede Products Ltd (0793 513855).

QuickC brought up to date

Microsoft has announced the availability of version 2.5 of QuickC and version 2.51 of QuickC-with-QuickAssembler, bringing these products in line with the recently released C Professional Development System V6.0. QuickC now incorporates the C 6.0 language extensions - based pointers, and `#pragmas` to force parameter passing in registers - plus improved ANSI conformance, a tiny memory model for .COM files and better data access and structure browsing. QuickAssembler remains essentially unchanged - you still need MASM V5.1 to do 286/386 work. Plain QuickC retails at £75, QuickC-with-QuickAssembler costs £125.

OS-9

OS-9 is a 680x0-based real time operating system which supports some UNIX-like features. The primary novelty of a new release, V2.3, is 'coloured memory' which allows designers the flexibility of assigning processes to different memory types; presumably fast, frequent processes get the static RAM. Microware UK, the manufacturer, is on 0489 886699.

20 MB in your pocket

Citizen - the company that makes the watches - has announced a 3.5" floppy drive that can read and write 20 MB of data per disk. What makes this feat especially impressive is that the drive can also cope with conventional 3.5" disks formatted to 720 KB and 1.4 MB. The drive has a SCSI interface, and will start shipping to US OEMs within a few months.

Ovum backs GUI

Ovum Ltd (071 255 2670) is a consultancy which periodically publishes expensive but thorough reports on IT industry trends. The latest, entitled 'The Business Desktop: the Next Five Years' (£660) predicts that the GUI will finally take off in the next few years, and that, in the future, vendors of desktop software will strain hard to make their products compatible with each other's.

Windows 3 SDK

Microsoft has shipped the Windows 3 Software Development Kit. The package costs £400, or £100 for an upgrade from a previous version. The kit includes a copy of CodeView for Windows, resource editing tools, optimisation tools and new source-code examples. You do not need to upgrade to C V6.0 to use it, C V5.1 is sufficient. A separate kit is available for developing device drivers.

POP++

Integral Solutions Limited (0256 882028) has combined its POP-11 AI language with the LISP Flavours system to produce an object oriented version of the language. No prizes for guessing what it is called. POP++ fits into the company's POPLOG development environment, and is available on Sun, DECstation, HP9000 and Apollo workstations, plus certain minicomputers.

Bye bye Lattice

Sad news, this. Lattice is transferring all responsibility for its C compilers (MS-DOS, OS/2, Amiga and various cross-compilers) to its parent company, SAS Institute Inc. By September, there will no longer be a Lattice C. Lattice will continue to look after its RPG II compiler, C libraries and various application software.

Serious compilers

I thought of MicroWay as a company that distributed frosty (but pricey) add-ons to make your PC go faster: transputers, interesting coprocessors, that sort of thing. It does indeed supply this sort of hardware, but it also has a line in 32-bit compilers, and this range has just been expanded and upgraded.

The NDP-486 FORTRAN, Pascal and (dual-dialect BSD UNIX and ANSI) C compilers use the same technique as Phar Lap's DOS extender to allow 32-bit applications to cohabit with MS-DOS. In fact, you can use them with Phar Lap's toolkit if you like - but you do not need it, and you do not have to pay any run-time license money on applications produced with the NDP software alone. The compilers support the Weitek 4167 floating-point coprocessor (if you have not got one, MicroWay can sell you one), and use special global optimising techniques to map code and data onto paragraph boundaries. This helps speed things up because it improves the chances of the 486 loading the whole of a code loop into its on-board RAM cache - enabling it to execute the loop without ever having to fetch instructions from slow external RAM.

Programs produced with these compilers are *seriously* fast, says MicroWay. The Whetstone single precision benchmark, compiled with NDP-486 FORTRAN, and running on a 25 MHz 486 equipped with a 4167, recorded 11.75 MegaWhetstones/second - faster than the floating point performance of a DEC 3100. The compilers cost £750 each. If you only run to a 386 machine (but you will need some sort of coprocessor, if only an 80287), then you might care to know that there is a parallel range of NDP-386 compilers, which has just been upgraded to V3.0. These cost £545 apiece. Further details from MicroWay, which can be reached on 081 541 5466.

Remote control PC

Co/Session is one of those packages that lets you run a remote PC from your own keyboard via a comms link; it feeds your keystrokes into the slave's keyboard buffer and echoes changes to the remote screen on your own. This is brilliant for providing technical support, via a phone line and a pair of modems, without having to go out on site. Special features of Co/Session include: graphics support up to VGA, a proprietary sliding window error-correcting comms protocol and a command processor (optional) which can perform scheduled tasks automatically. The basic pack costs £199.95, the add-in Script processor another £99.95, from Megatech (081 874 6511).

OOP Prolog Standard

Quintec Systems Ltd, noting the alarming proliferation of Prolog implementations with OOP extensions, has suggested that the software houses involved should adopt an industry standard of syntax for implementing objects. Integral Solutions' POP++, LPA's Prolog++ and Quintec's own Quintec-Objects all offer similar features: encapsulation, class inheritance etc. Quintec says that its system has been well received from a technical standpoint, but potential customers have expressed concern that there is no agreed standard for OOP extensions.

If Quintec has any success with its proposal, perhaps it might care to pass on its wisdom to Borland, Microsoft and JPI. Borland and Microsoft have already created two incompatible sets of Pascal OOP extensions; JPI may produce yet another when TopSpeed Pascal appears later this year.

SSADM for dBASE

The phrase 'Structured Systems Analysis and Design Methodology' (SSADM) conjures up images of government contracts, huge mainframes, vast software projects... Checkpoint Computers Ltd of Berkshire says it has tamed SSADM, reducing it to a concise set of manuals that it would like to sell to you for £99 (inc VAT and P&P). 'Rapid Database Standards', as the manual set is called, is targeted at the dBASE user (like nearly everything else this month). According to Mr Jim Hackett, MD of Checkpoint, the company has been able 'to reduce the jargon prevalent in the mainframe standards' and offer practical tips 'which highlight errors before they become expensive and embarrassing.'

The 'Rapid Database Standards' set of manuals is available now. Checkpoint can be reached on 0488 71467.

Oracle to Clipper

Biton (rhymes with 'right on') is a Clipper (Summer '87, but a Clipper 5 version promised soon) library that provides connectivity with the Oracle RDBMS. The idea is that you use Clipper to throw together an elegant front-end, but retain Oracle for the heavy database work. There are side benefits as well; for example, you can send you calculations down to Oracle, it can do them in 62 digit precision arithmetic.

Biton is principally aimed at corporates who wish to get PC programmers up to speed with the company database without having to retrain them. It costs £400, and comes direct from the manufacturer, a company also called Biton (0727 50658). .EXE

dBASE Graphics

If you use dBASE, Clipper, Foxbase, Quicksilver, Force, dBFAST, Vulcan or R:BASE, you may be interested in the latest version of the dGE business graphics package (exploding pie charts etc). Version 4 includes Supertext with variable font size, new type faces and an editor, file-based icons, a driver for colour dot matrix printers, mouse functions and a Norton Guide. It costs £245 from Bits Per Second Ltd (0273 727119).

Index race

dB Race creates new indexes for dBASE compatible data files. Because these indexes are smaller, it is claimed that it can perform sorts and searches in as little as one tenth of the time of the conventional software. dB Race, which is sold as an add-on for dBASE III+ and clones, costs $399 from its US creator LoadStone (0101 704 568 8095).

It's Baby Ada

Milspec Systems can do you a PC Ada compiler for £99 ex VAT. The drawback is that Personal Ada V2.0 only lets you have 64 KB of code. Based on the last time I witnessed an Ada compiler in action, I would estimate that this restricts you to the 'Hello World' program, only leaving out the 'World' - but I dare say Ada has come on a long way since then. The proper, full-sized compiler costs £359, and there's also a new graphics library, priced £99. Milspec is on 0203 670770.

3 for II

*APL*Plus II Version 3 is the latest release of a 32-bit version of APL from STSC International. It contains its own MS-DOS extender, so it can move its interpreter and new session manager into extended memory and switch the CPU into protected mode. You can then load DOS TSRs, such as network drivers, 'underneath' the APL without interfering with it. Other new features include an interface to Lotus 1-2-3, and mixed language programming with FORTRAN. STSC's number is 0753 831451.*

Intel cross compiler

Microtec Research (0256 57551) has announced MCC86 V2.0, an Intel 8086/186/286 optimising C cross compiler which it says is fully ANSI conformant. Hosted on Sun workstations and PCs, the compiler produces re-entrant ROM-able code for the above-mentioned CPUs. There is also target support for the NEC V20-V35 range of processors, and a degree of Microsoft compatibility - for example, near and far pointers are supported. The object code is in Intel MSC-86 object module format.

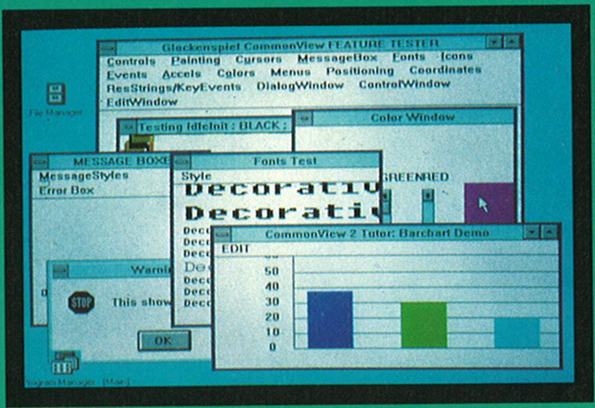
Objects of Desire

glockenspiel CommonView 2

***Glockenspiel CommonView** has really made its mark in the world of Windows development. Thousands of developers have used it to speed up and simplify their projects.*

Now **CommonView 2** is available, inheriting the success of its predecessor and extending its capabilities even further to deliver efficient Windows 3.0 apps.

That's because **CommonView 2** works with **Glockenspiel C++ 2.0**, giving you a C++ object-based framework that reduces the complexity, cuts the code, manages memory and lets you stay in touch with what you're really doing. From compilation to execution, **CommonView 2** applications are fast and powerful.



CommonView 2 objects model the real world of Windows. And that's just the beginning - from there **CommonView 2** takes you as far as you want to go.

It doesn't anticipate everything. That's where C++ takes over: its inheritance capabilities enable you to extend the **CommonView 2** framework. Just take an existing object and customize it without affecting the original. A few additional lines of code and you could, for example, turn an edit control into a password control. Then reuse it in other applications.

You *don't* have to learn a complete new language, you *can* integrate existing developments; it *is* portable to PM and NewWave; CodeView *can* be used on your C++ source.

The world wants Windows 3.0 apps now! And with **CommonView 2** you can inherit the earth.

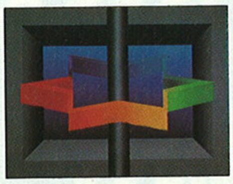
Specifications.
Glockenspiel CommonView 2 includes Glockenspiel C++ 2.0 and Container - the object storage framework. It requires Microsoft C 6.0, the Windows SDK and 1.5 meg of memory. You debug C++ source with Microsoft CodeView 3.0. Glockenspiel C++ supports a completely portable memory management system. Glockenspiel CommonView consists of approximately 65 classes.

Comprehensive documentation includes CommonView tutorial and reference manual, Glockenspiel C++ compiler manual and User Guide, C++ syntax and AT&T Library Guide, pullout guide to compiler switches, *plus* "Programming in C++" by Stephen C. Dewhurst and Kathy T. Stark (Prentice Hall).

On-line hypertext documentation for CommonView reference manual and AT&T guides. Tutorial source code also on disk.

Glockenspiel C++ works from within the Programmer's Workbench with the reference guides instantly available from the on-line Advisor, using Microsoft CodeView for debugging.

Glockenspiel CommonView applications are portable between Windows 2.1 and Windows 3.0, PM 1.1 and PM 1.2 with HP New Wave 3.0 version coming soon.



glockenspiel
class constructors

QA

QA Training Limited,
Cecily Hill Castle,
Cirencester, GL7 2EF.
Phone: 0285 655888. Fax: 0285 650537.

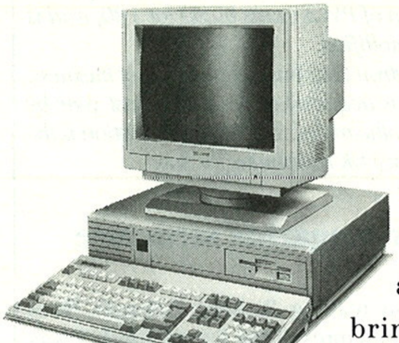
CommonView costs £495 + VAT and is available for Windows 3, OS/2 Presentation Manager and HP NewWave.

Glockenspiel Professional C++ 2.0 Compilers are available for DOS, OS/2 and Workstation platforms. Call for details.

Glockenspiel CommonView and Glockenspiel C++ are registered trademarks of Glockenspiel Ltd. The trademarks of their respective corporations are acknowledged.

CIRCLE NO. 127

Tandon launch the fastest 486 computer under £5,000.



Which is more mind bending: the speed of our new PCAsl/486 or the £4,999 price tag?

Let's look at the speed first. For starters, there's an Intel 80486 processor that crunches numbers like they're going out of fashion.

(Tests have indicated that the 486sl runs at a break-neck 10.3 m.i.p.s.)

Just as hair-raising is the 486's built-in maths co-processor (it tots up figures faster than a bookie on Derby Day). And our unique Power Poster feature, a high speed cacheing system, sprints into action so quickly it'll bring tears to your eyes.

However, £4,999 doesn't only buy you sheer unadulterated speed. There's a cavernous 110MB of hard disk storage capacity and the high clarity VGA colour monitor makes the most humble pie charts look tasty.

And don't forget that the 486sl can use not only existing PC compatible software, but also the latest 32-bit graphical interfaces such as Windows 3.

Take heed though, at under £5,000 we predict the 486sls won't be hanging around for long.

Tandon

For more information on the Tandon PCAsl/486 write to Tandon plc, FREEPOST, Hunt End, Redditch, Worcester B97 5XP. Or call us on (0527) 550550.

Name.. *Position*.. EXEJ/486

Company.. *Address*..

....

Telephone.. *Number of employees*........ *Number of PC's installed*........

Prices exclude VAT. 80486 is a registered trademark of the Intel Corporation. Windows 3 is a registered trademark of the Microsoft Corporation.

CIRCLE NO. 128

Letters

We welcome short letters on any subject that is of interest to our readers. Please write to The Editor, .EXE Magazine, 10 Barley Mow Passage, Chiswick, London W4 4PH. Unless your letter is marked 'Not for Publication', it will be considered for inclusion on this page.

Polytron saga

Sir,

I am enclosing correspondence *(not reproduced - Ed)* that I have had with Polytron concerning the use of their version control system. As you can see from the letters I sent them, the PVCS system has been corrupting files - an unforgivable feature of any program, but particularly of a version control system! The letter (with no originating address) recently received from a software engineer acknowledges that the product had a bug of this sort and recommends me to upgrade to version 3.3.

Fair enough. I telephoned Grey Matter and they referred me to the UK distributor for upgrades - a firm called Software Generation. A very helpful person there said that since I had had the product for more than 12 months, I would have to purchase the product again - at a cost of £495. At this point I complained and pointed out that a) the product I had purchased had failed to work as advertised and b) I was a registered user of this (and many other) Polytron products and was not provided with any update information at any time.

The helpful person said that this was unfortunate but couldn't be helped since Polytron themselves had gone out of business and basically I would have to start over again. (I then understood why the software engineer in the US did not write back on Polytron business paper - or indeed from any organisation at all).

So I have been had. I purchased a program which failed to do what it was advertised to do - worse, it actually did the opposite! And now I have been told that the only way to rectify the situation is to fork out another £500. Readers of .EXE beware. Polytron PVCS corrupts files under a number of circumstances - and you'll have to pay for the privilege of finding out whether the new product does the same!

Peter Chapman
Energy Advisory Services
Hanslope

This story has a happy ending. We sent a copy of this letter to Software Generation and, as a result, the company experienced a change of heart. Prof Chapman has been offered an upgrade to the latest corporate version of PVCS (sans bugs) for £80, and is now mollified.

Polytron itself has not gone out of business, but was acquired at the end of last year by Sage Software Inc. Software Generation is the exclusive UK distributor for Sage.

Poor magazine structure

Sir,

Upon reading Richard Pickard's 'Program Structures of the Fourth Kind', I was amused to find that the article read in the order pages 27, 34, 30, 33 and finally, 28. Was this accidental or was it some sort of sick joke on your part?

Steve Dix
Dowty Magnetics
Staffs

Sir,

In your July issue, the excellent article 'Program Structures of the Fourth Kind' seemed to be missing three things: Labelling (page numbers on some of the pages), GOTOs (to tell you which page to go to next) and Block Structure (pages started mid sentence!). Luckily I managed to find the correct sequence by using the figure numbers.

Can we have page numbers on every page please - and prompts such as 'continued on page ...'; and surely in these days of computerised typesetting, we don't need to split sentences between pages!

Clive Craske
ROCC Training
Crawley

Many apologies to Richard Pickard, whose article was messed up. If you abandoned an attempt to read it as a result of the foul-up, please do go back and give it another shot, as it will certainly repay your effort.

This was a rare-ish example of a genuine printer's error (two half-pages of editorial were exchanged), as opposed to far more common goofs such as typing er1234rors, wrong picture captions etc, which originate in this office. I have forwarded Mr Craske's suggestions to She Who Controls The Layout, and her answers are: numbers on pages - sorry, no can do, would cause hassle with our advertisers; sentences not split across pages - not convinced this is necessary; 'continued' - good idea, she had been advocating it for yonks, watch this space.

Sparks from May

Sir,

If Jules May (Soapbox, .EXE July 1990) is such a good programmer that he has produced only one bug in 10 years of programming, why does his choice of programming language matter?

G M Wright
Wormley
Surrey

Sir,

Well done to Jules May! It was about time that somebody said it!

C J Glick
London

Contented Fractint

Sir,

First, many thanks indeed for getting a copy of Fractint to me within four days of my sending you a disk. That's a performance that most software companies and shareware libraries couldn't match!

Unfortunately, I happen to be one of those unfortunates who do not own a modem, so I'd be grateful if you could pass on my thanks to the authors of the program. I've had a couple of earlier versions and all of them have given me more pleasure than any arcade game. I'm not a C programmer, so I can't contribute to the project directly, but I would like to suggest one useful add-on for a future version; support for colour printers and (especially) plotters. HPGL would be preferable. I generally use a camera for hard copy, but it would be nice to get something really accurate, without the inevitable distortion of a curved screen etc. It would be especially useful with the 3D images.

Marcus L Rowland
St Marylebone School
London

EXE

An object lesson in programming

C++

Meet Your Objective

Object-Oriented Programming (OOP) is programming for the '90s. It's the next step after structured programming and is a much more productive way of writing applications. Borland has combined the power of OOP with the efficiency of C to produce new Turbo C++ Professional®.

Turbo C++ Professional is the first Turbo-charged native code C++ compiler that brings Object-Oriented Programming to your PC. Since Turbo C++ Professional also compiles ANSI C code, you can be productive with C now, and move to C++ at your own pace.

Environment ++

The best compiler deserves the best environment and our new Programmer's Platform® turbo charges your productivity. It features overlapping windows and mouse support, as well as a new multi-file editor, an integrated debugger, and a smart project manager. Its advanced open architecture lets you integrate the tools you need and are familiar with.

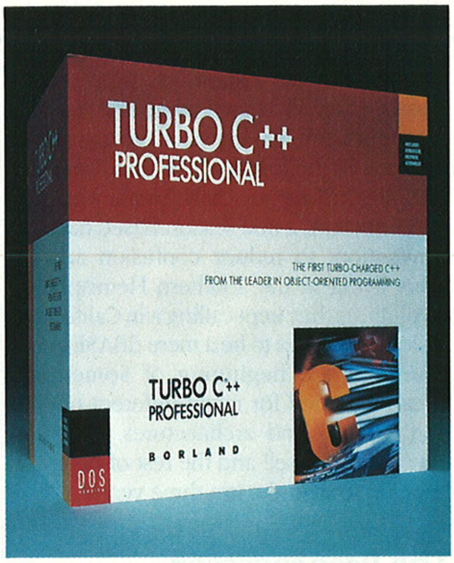
VROOMM adds room

VROOMM® (Virtual Run-time Object-Oriented Memory Manager) lets you break through the 640K barrier. Just select the application code you want to overlay, and VROOMM does the rest – swapping modules on demand. It's fast, easy, and automatic.

Another +

Turbo C++ Professional gives you all the tools you need to build fast, reliable C++ programs.

Turbo Debugger® 2.0 debugs your object-oriented programs. This powerful new version is the first and only debugger to support reverse execution, letting you step backwards through your code to find the bugs



you might have missed.

New Turbo Profiler®, the world's first interactive profiler, gives detailed analysis of your program's performance. With it, you can easily spot execution bottlenecks and see where improvements or redesign of your code will yield maximum performance gains. And Turbo Assembler® 2.0 lets you replace time-critical segments of your code using the world's fastest MASM® compatible assembler.

Buy objectively

The suggested retail price for Turbo C++ Professional, including Turbo Debugger, Turbo Assembler and Turbo Profiler is £249.95 plus VAT. Turbo C++ costs £149.95 plus VAT. For further information complete the coupon and return or call our PRODUCT INFOLINE on (0628) 771070 or simply talk to your dealer.

Turbo C++ Compiler

- C++ conforming to AT&T's 2.0 specification
- C++ class libraries
- Full ANSI C compiler
- VROOMM overlay manager
- Complete documentation and tutorials

Programmer's Platform

- Open architecture for integration of your own tools
- Overlapping windows with mouse support
- Multi-file, macro-based editor
- Smart project manager provides visual MAKE
- Integrated debugging and hypertext help

YES! Please send me a free Turbo C++ demo disk. ❐ $3^{1/2}$" or ❐ $5^{1/4}$"

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CIRCLE NO. 129

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Not so much a compiler, more a statement of direction

Clipper V5.0 is ending its career as vapourware. Ian Butterworth has been taking a look at the latest dBASE-ish compiler from Nantucket.

dBASE World

Welcome to the first thematic issue of .EXE Magazine. Although entitled 'dBASE World', we have ended up with a heavy Clipper bias. Perhaps this is partly a reflection of Ashton Tate's current difficulties; and perhaps also that, because it is a compiler, Clipper is the Developer's (as opposed to the Lay User's) favourite.

The names on the continents and satellites in our cover illustration were produced by going round the office, inviting everybody to name all the PC-based DBMSs that they could remember. Omitted manufacturers should therefore address complaints to their own marketing people, and not to me. *WRW.*

The original dBASE compiler was written by Brian Russell back in 1984. He took it to Ashton Tate, the dBASE manufacturer, but the company wasn't very interested. So one evening Brian Russell met one Barry ReBell in a restaurant called *The Nantucket Light.* The upshot of this occasion was the formation of the Nantucket Corporation, with ReBell as Chairman. The company's product was Russell's compiler, which was launched as Clipper Summer '85.

Since that time, Clipper has grown to be pretty successful, with over 200,000 users worldwide. One consequence of this success is that Clipper has been able to create its own (dBASE-incompatible) *de facto* standard, and has spawned a whole community of developers of both end-user applications and add-on products.

The current (pre V5.0) Clipper release is Summer '87. At the US Nantucket Developers' Conference in California, which I attended a few weeks ago, we were given 'The Conference Edition of Clipper 5.0'. This is, in effect, a gamma release version of the software; it is this package that forms the basis of the following review. The new compiler marks a radical break with the past - not least a non season-based naming convention, to reduce confusion among users living in the Southern Hemisphere. Five-Oh, as they kept calling it in California, no longer aspires to be a mere dBASE compiler, but the beginning of Something Great, intended for many different operating systems and architectures. So what have Brian Russell and the rest of his team been up to over the last three years?

The Preprocessor

The facilities offered by the new preprocessor will be boringly familiar to C programmers - but very exciting to dBASE language developers. There are directives `#define` and `#undef`, for the creation (or deletion) of manifest constants, pseudo-functions and so on; `#include` to incorporate header files (containing all those `#defines`), `#ifdef`, `#ifndef`, `#else` and `#endif` to allow conditional compilation.

Two other directives, geared specifically to Clipper syntax, are less familiar. `#command` turns what appears as a command in the source file into a function call. Many of the existing Clipper commands have been reimplemented this way, and it provides a powerful mechanism for substituting other database engines, screen drivers etc into the same source code. `#command` allows a variable number of parameters, the ability to wrap parameters in quotes (for example, as in the `USE` statement, which normally takes a literal file name) without changing any of the source. `#translate` expands four-letter abbreviations of commands (a hangover from interpreted days) into the full version, but otherwise behaves just like `#command`.

Scoping and Data Types

Another hangover from the interpreter is Clipper's weak set of scoping rules. If I declare (ie use) a variable name within a procedure, any routine that it calls can 'see' that variable. If a procedure with a loop `FOR i=1 TO n` calls another routine with a loop `FOR i=1 TO n`, the caller's variable `I` is changed by the inner one! Until now, the only way to prevent this happening was to declare all local data as private - which left the responsibility of hiding data to the called and not the caller.

There are two new variable declarations: `LOCAL` and `STATIC`. `LOCAL` means that the variable is only visible in the routine in which it is declared, and it is stored on the stack. This appears, on the surface, to be a minor point, but I believe it will make Clipper code generally more robust.

`STATIC` is like a C `static` - its value is retained between invocations of a routine. For convenience, `STATICs` can have file-wide scope (when compiled with the /N switch, a module's `STATICs` are visible to all its routines). `STATIC` is a very useful mechanism for data hiding. Previously, one had to declare a large number of `PUBLIC`

Clipper V5.0 new features

- Preprocessor
- Better scoping and new data types
- Source-level debugger
- Database independence
- New operators and functions
- A new dynamic linker

variables which could then be trashed by any careless piece of coding. Now, the details of libraries can remain safely hidden from applications.

LOCALs and STATICs have a number of other features in common: for one thing their names are resolved at compile time. PRIVATE PUBLIC and, a new one, 'FIELD' variable names are known at runtime, which means they can be used in macro substitution. The snag is that each has an overhead of 22 bytes per variable name. LOCALs and STATICs lose this memory overhead, plus one level of indirection, so we should be able to look forward to better performance in accessing memory variables.

There are also such things as STATIC functions, which are visible only in the module in which they're defined. Once again, this serves to enhance the hiding of program and data. Henceforth there should be less use of undocumented (and therefore changeable at Nantucket's whim) Clipper functions. For those who don't see what is wrong with this sort of thing, consider how many Microsoft Windows V2.X developers now wish that they had used memory as they were told?

Another aspect of the generality of Five-Oh is the introduction of code blocks, which can be thought of as pointers to functions. Essentially, you can assign a chunk of code to a variable at compile time (thus avoiding the overhead of runtime macro expansion). This chunk of code can be passed around just like any variable and executed using the function eval(). Here is a code block which takes the parameter yy, passes it to func and then increments it:

```
xxblock := {|yy| func(yy), yy++}
```

Code blocks are often used in internal functions. By default, asort() sorts an array into ascending order. By passing the code block parameters, you can force descending order or specify behaviour for dealing with two different test data types.

Arrays have been expanded to structures of potentially quite labyrinthine complexity - not like arrays in any other language that I have seen. Previously, array elements could be of different types, perhaps reflecting the structure of whole database files. This has been expanded to allow arrays to contain references to other arrays, so we have the possibility of an unlimited number of dimensions (except for memory limitations). Arrays can now be initialised when they are declared:

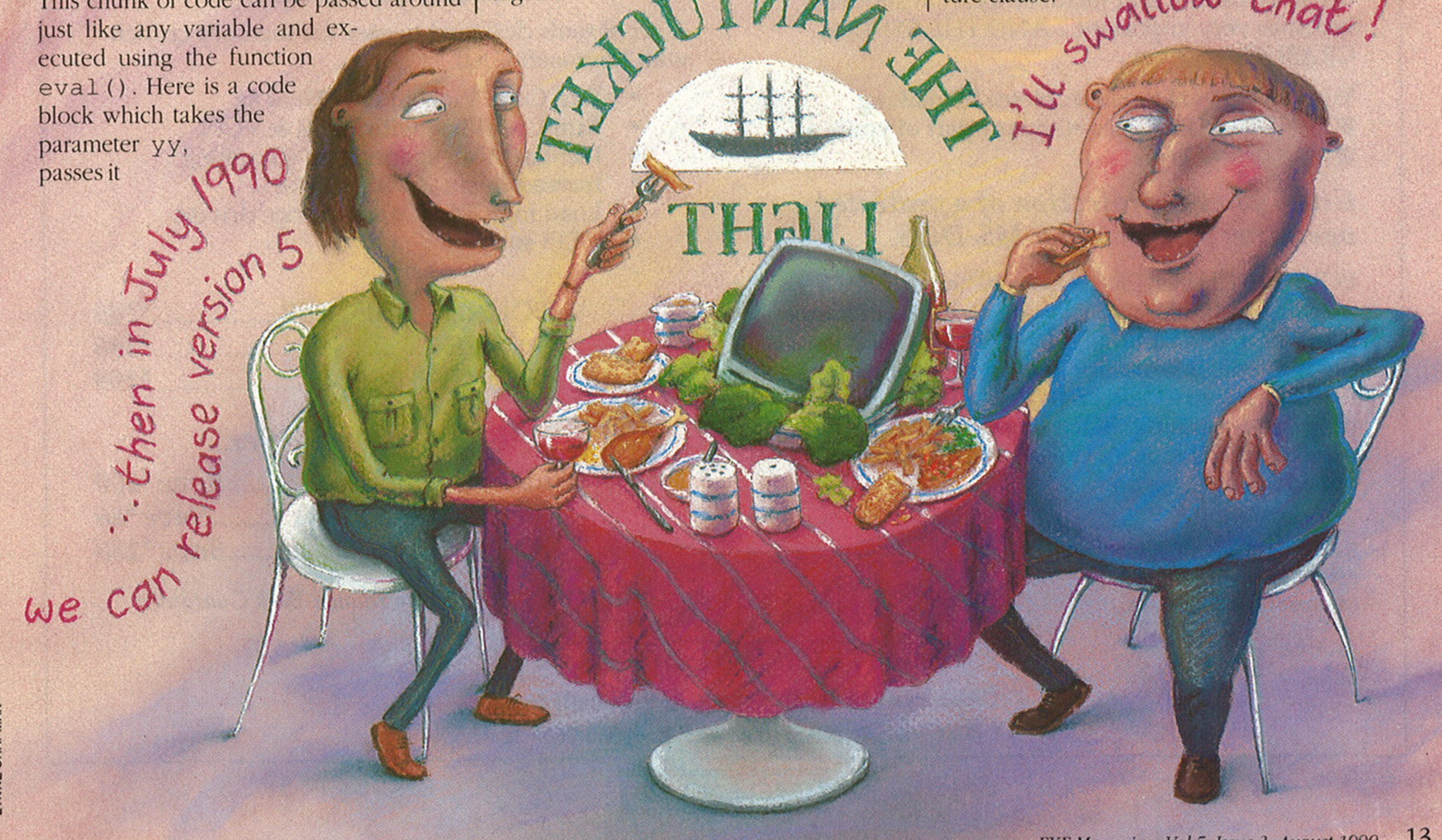
```
LOCAL nice_lads := {"Smed",;
        "Malc", "Mark", "Skye",;
                  {38, 25, 32, 47}}.
```

Some functions to handle the new arrays are shown in Figure 1. You can now declare LOCAL parameters in a style reminiscent of FORTRAN: function AtSayCol(nRow, nCol, cText, nColour). These parameters are all 'genuine' ie actually passed on the stack, with scalars passed by value, multiples by reference. For these purposes, a string counts as a scalar. Parameters may be skipped in function invocations by the simple expedient of placing two commas together - the called routine is passed the new constant NIL. FIELD is the last new data type and is used to define memory variable names for use with a particular database. It is most useful to the programmer who duplicates field names all over the place (forbidden practice in my company).

GETting better

One outstanding weakness of the current system of obtaining input is the inability to nest GETs. For example, if you are entering data against an order, and suddenly discover that your database doesn't have the required code for some new product, the only way around it is to abort the read, go to the product entry screen, type in the new product data and then start all over again from scratch.

Five-Oh's GET system solves this problem. You are now allowed to have multiple GET lists on the go. You can either suspend the current GET list and drop down to an inner level (nested GETs), or, for the ambitious, you are allowed to have more than one list running simultaneously (parallel GETs). Other new features include: full program control over navigation and editing keys, cargo information associated with each GET allowing (eg help text to be displayed when a user is entering data in a particular field); the availability of state information (insert key status and so on); and dynamically configurable state information such as colour and picture clause.



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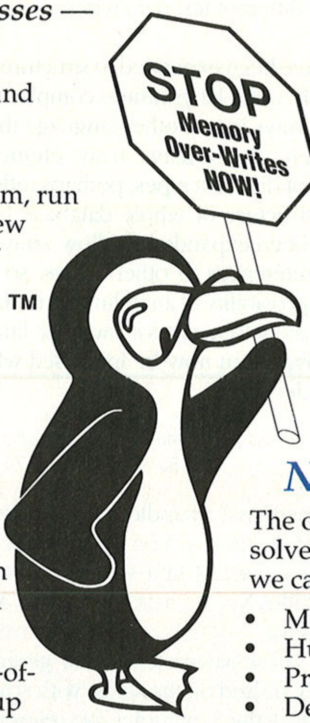

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CIRCLE NO. 130

Figure 1 - Operators and Array Functions.

Operators

Operator	Example	Meaning
:=	x := y	x = y and return the value y to LHS
+=	x += y	x = x + y if numeric or concatenate if character
-=	x -= y	x = x - y
*=	x *= y	x = x * y
/=	x /= y	x = x / y
++	x++	x = x + 1 also in prefix form
--	x--	x = x - 1
^= or **=	x ^= y	x = x ^ y Exponential
%=	x %= y	x = x MOD y

Array Handling Functions

Function	Example	Meaning
aclone()	x := aclone(y)	Make an exact copy of this array
aadd()	aadd(x, y)	Add element y to array x
asize()	asize(x,5)	Make first dimension of x 5
acopy()	acopy(y,x)	Copy all elements of y to x
aeval()	aeval(x, y)	Execute codeblock y on each element of x

The other array functions appear to work in a similar fashion to Summer '87.

The revised system is based on things called 'GET objects' - which, as a confirmed OOP-o-phobe, makes me nervous. The preprocessor translates each `@...GET` command into an object which contains characteristics of the `GET` command itself. Each `GET` is added to an array called `GetList`. `GetList` is `LOCAL` to the routine in which it is defined, so nested `READ`s become a natural part of the way the language works, and not a bolted-on work-around. When a READ command is issued, the preprocessor translates it into a call to the standard function `readmodal(GetList)`. The default method of operation is as in Summer '87.

The values in `GET` objects are set and retrieved using code blocks which are evaluated at runtime. It is possible to assign a new value to the `GET` variable or just retrieve its value. The `GET` object needs to know practically nothing about the variable being 'GOT'. Validation can now be carried out before, during and after the variable is being GOT. For example, a VALID clause is now translated to be a code block executed after variable entry.

I have not yet had time to investigate all the ramifications of this new approach, but it does not take much imagination to see how one might implement a multiple window application where the user can switch between activities at will - suspending some and activating others according to need. The new `GET` code itself has been written in Clipper - the source file GETSYS.PRG is supplied - so it is very user configurable.

The Browse System

The new Browse system (replacing the slightly strange `dbedit()`, although `dbedit()` is still available in this release) is implemented in a similar style to `GET's`. As the reference manual says, 'A TBrowse object is a general purpose browsing mechanism for table-oriented data'. Data retrieval and record positioning is implemented via user-supplied code blocks passed as messages to the TBrowse object in question.

A TBrowse object is created using the function `TBrowseNew()` which defines the name of the object and its screen size. New columns (ie data fields) are created by passing the `AddColumn` message to the browse object - please see Figure 2. Each column or block of cells may be individually coloured, so you can easily highlight queried data or negative values. Colours are also set by passing messages.

Stabilisation is the process whereby the screen is redisplayed after movement within the database(s) being browsed. It is often convenient to be able to prevent/abandon this process (for example when the user is paging down rapidly) so you do not waste time redrawing the screen when the next keystroke, waiting in the keyboard buffer, will force another refresh. Five-Oh lets you do just this, so the user can move to the next screen of data without having to wait for the current screen to fill up (which may take some time, if complicated look-ups are involved).

Although TBrowse and `GET`s act like objects, the manual is at some pains to say that Five-Oh is NOT an object-oriented language.

Database Independence

Although I touched on database independence in the context of user defined commands, a little more should be said about it. By including non-standard header files to, it is possible to reference another set of functions to perform data retrieval. This should mean that the lonely freelancer, toiling in his garret, can develop with a dBASE III+ compatible file structure, then, once it is ready for delivery, recompile using a non-standard header file and, lo and behold, it's Netware SQL or whatever the customer wants.

Drivers should be available both from Nantucket and third parties over the next few months. The following drivers have been mooted: Paradox, Microsoft/Sybase SQL Server, Gupta Technologies SQLbase, Novell's Netware SQL and Oracle RDBMS. Note there are Summer '87 drivers available for Oracle and SQLbase.

```
Function BROWSEDIR( aBrowse, nTop, nLeft, nBottom, nRight , cMatch)
Local oBrowse, oColumn, nElement := 1, lCont := TRUE, I, nKey

oBrowse := TBrowseNew( nTop, nLeft, nBottom, nRight )

oBrowse:goTopBlock  := {|| nElement := 1 }
oBrowse:goBottomBlock := {|| nElement := Len( aBrowse[1] )}
oBrowse:skipBlock   := {|nMove| SkipArray( nMove, aBrowse, @nElement )}

oBrowse:colorSpec := "N/W, B/W, B/BG, R/W, W+/R, GR/BR ,+GR/B"

oColumn := TBColumnNew( "File Name", {|| aBrowse[1,nElement]} )
oColumn:width := 13

SetColor("N+/N");@ nTop ,nLeft + 1 Clear To nBottom + 2, nRight + 3
SetColor("B/W");@ nTop - 1,nLeft - 1, nBottom + 1, nRight + 1 Box BOX_SINGLE

Do While (lCont)
//Stabilise browse (until done, or keystroke hit)
Do While (! oBrowse:stable) .And. ((nKey := InKey()) == 0)
oBrowse:Stabilize()
EndDo

//...Everything stabilised
If oBrowse:stable
If nKey == 0
nKey := InKey(0)
EndIf
EndIf

//...Handle keystrokes
Do Case
Case nKey == K_DOWN
oBrowse:Down()
Case nKey == K_UP
oBrowse:Up()
Case nKey == K_ESC
lCont := FALSE
EndCase
EndDo

Return (NIL)
```

Figure 2 - Manipulating a TBrowse Object.

Figure 3 - An RTLink command file.

```
#                  Dynamically overlay an application and use a shared
#                  library

DYNAMIC            # Turn on dynamic overlaying
INCREMENTAL        # Link only changed modules
PLLNEEDED qb51ib   # Link to shared library
FILE mainprog      # User program file
#                  No need to mention Clipper.lib
# Many of the defaults can be set up using the RTLINKCMD environment variable.
```

Miscellaneous Goodies

The assignment operator := returns a value C-style, so multiple assignments can be expressed on one line, as in `x := y := 0`. See Figure 1 for a list of the other new operators. The macro operator can now be used on expressions; before it used only to work on simple variables - not even array elements. The syntax is `&(str1 + str2)`.

Runtime Environment

Clipper 5.0 comes with a simple program editor (actually itself a Clipper program), DBU (a utility program), a source level debugger and a new linker. The editor is pretty basic, and not likely to win many friends. DBU provides facilities for the creation and modification of DBF files.

The debugger is a full screen effort, with one small window for entering commands plus a menu accessed via ALT-key combinations. The main debugger window is given over to the source code being executed, with a highlight on the current line. To set break points, you move the cursor to the line in question and press F7. I have heard rumours that there will be an option to run EGA or VGA screens in 43/50 line mode, with the application screen occupying half and the debugger the remainder - let's hope this is right.

The linker is a vast improvement on PLINK86 - it is faster and it helps to get round one of the bugbears of all Clipper programs - size. The design of the Clipper language requires that much of the Clipper library has to be loaded with each application. This means that a 'Hello World' program in Clipper is around 160 KB! The new linker, a special version of RTLink from PocketSoft, provides several two features to enhance both memory and disc usage: dynamic overlaying and shared library files. In order to speed up the link process incremental linking is available - only changed modules are relinked into the application. Because this special version of RTLink knows about Clipper, basic linking can be carried out with the simple command `rtlink <objfile>`. Response files, such as shown in Figure 3, can be used for more complicated link sessions.

The runtime environment takes a more setting up than before, now that we have include files, dynamic link libraries *et al.* Five-Oh now installs itself into a directory CLIPPER5 with five sub-directories BIN, INCLUDE, LIB, PLL and SOURCE. Fortunately the environment can be set up à la Microsoft, and both the compiler and the linker know about SET INCLUDE, LIB etc.

The compiler itself now takes a greater number of optional parameters, see Figure 4. The package comes with a Norton Guides engine and database, to enable hotkey look-ups which are context-sensitive to the item under the cursor in your editor. A Make utility is also supplied.

Performance

Caveat: this is only pre-release software. Performance was a little disappointing; about 15% slower to compile, producing .EXE files about 10% larger - although this is probably inevitable when supporting dynamic linking. Compared to using PLink86, linking was about three times faster. Running applications, we found that indexing (a traditionally heavy-duty number) was about 15% slower. Nantucket has promised that the released compiler (and its resulting executable) will perform at least as well as Summer '87.

What's the same?

As far as we can tell, Five-Oh is completely source code compatible with Summer '87. An existing application (which only used the Clipper and Extend libraries) had *exactly* the same bugs when recompiled.

In the manual, commands and functions which are obsolescent are marked with an asterisk. We have due warning about what is to be dropped. Generally, the functions marked for deletion are those which are hangovers from interpreted dBASE (eg `CALL`, `TEXT`).

There has not been a vast increase in the number of core functions - if you want graphics, or need to use the mouse, then you'll still have to buy an add-on package. The third party developers have had beta copies of Clipper for some months, so most add-on libraries should be ready shortly after the release of Clipper 5.

In Conclusion

So what has the Clipper development team been doing these last three years? Well, they appear to have spent about 18 months reading a lot of C manuals. They seem to have thought pretty hard about how developing ought to be. I think that they have created an open and very usable compiler. I, for one, am keener to get my hands on the full release than before. Oh? So I like it then? Yeah!

The question that remains is 'When is it actually coming out?'. I think the answer is that we should start seeing it in the UK around the end of July.

EXE

Switch	Meaning
/A	Automatic declaration of PUBLIC & PRIVATE
/B	Include debugging information
/D<ident=text>	Define an identifier
/I<path>	Additional search path
/L	Suppress line numbers
/M	Compile single module only
/N	Suppress automatic main procedure
/O<objfile>	Specify output object file
/P	Produce preprocessor listing
/Q	Quiet mode
/R<libfile>	Embed a library in addition to Clipper.lib
/S	Syntax check only
/T<path>	Path for temporary files
/U<user header>	User's standard header file
/V	Treat all variables as memory (not field)
/W	Generate warning for ambiguous variables

These switches can be set up in the environment using the command: SET CLIPPERCMD=

Figure 4 - Compiler Switches.

Ian Butterworth is a director of Software House and Distributors Quin Butterworth Spangenthal Ltd. Like many ageing programmers, he started off using punched cards on mainframes and ended up working mostly on PCs. Although he still likes to keep his hand in with FORTRAN and COBOL, these days he spends most of his time writing applications in Clipper.

QBS distributes the Blinker linker, reviewed elsewhere in this issue.

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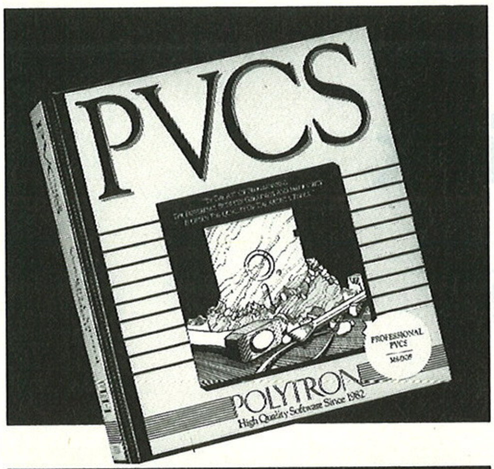

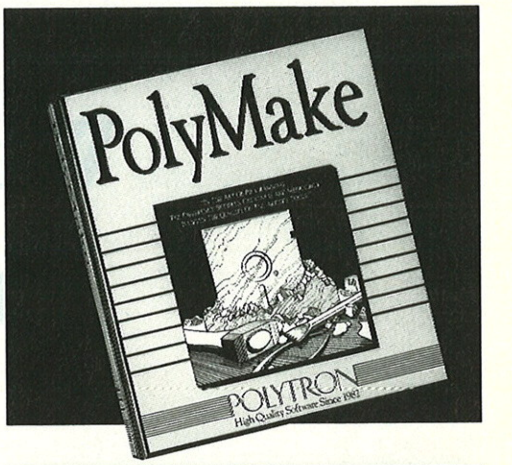

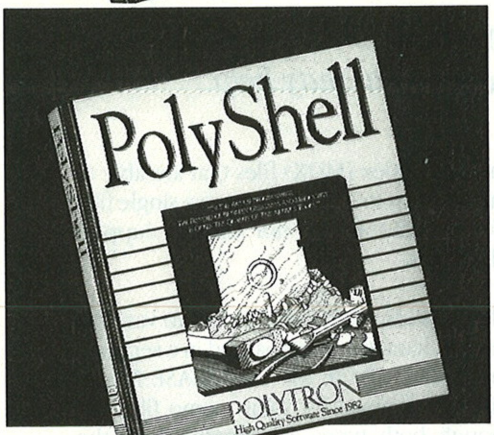

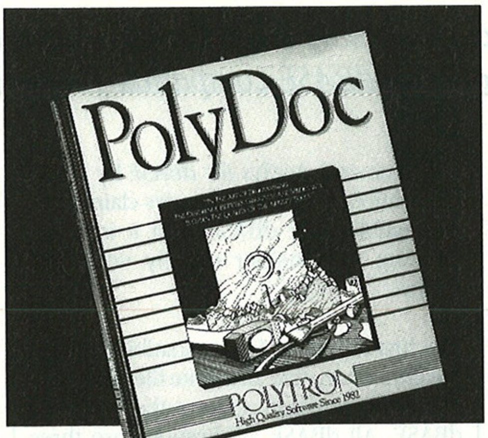

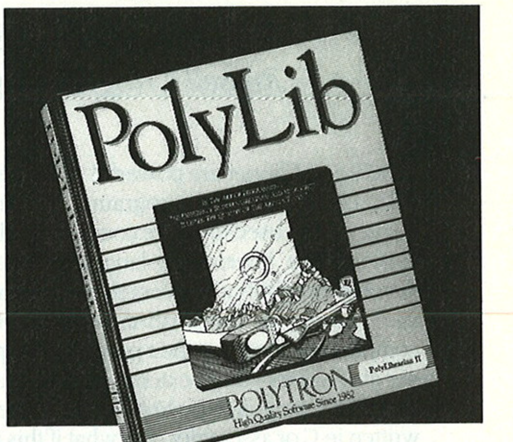

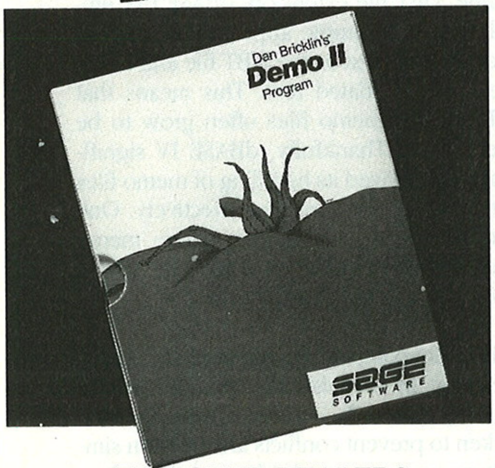

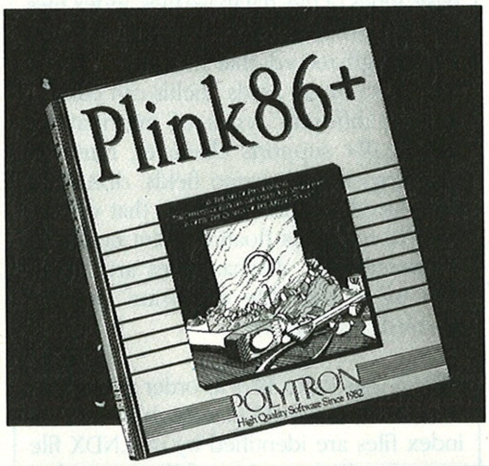

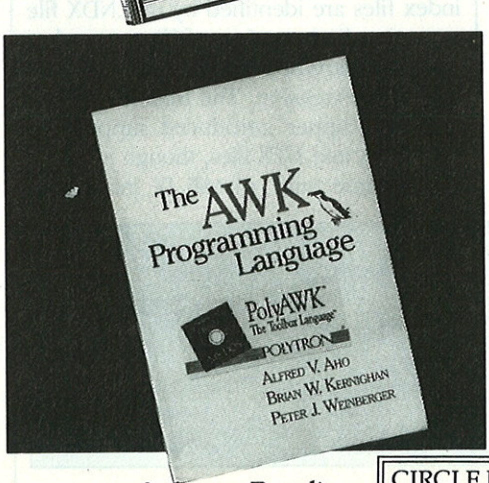

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Where the Quick meets the Easy

Do you need dBASE compatibility but feel constrained by dBASE or Clipper? Russell Craigie looks at three dBASE-compatible file managers that may help.

dBASE and Clipper are powerful packages. dBASE's interpreted programming language can be used to create complex applications. The interpreted language eases development but can be very slow, so many use Clipper, or other dBASE-compatible compilers to speed up their programs. Clipper also allows you to extend the power of the dBASE language by linking in routines written in C or assembler. But what if this is not enough? What if you need to maintain dBASE compatibility without using dBASE or Clipper? What if you would like to access dBASE files using the C programming language?

This article looks at three function libraries that allow C programs to access files that are compatible with the files produced by dBASE III+ and dBASE IV. You retain the full power of the C language (for example, allowing the use of low-level code that accepts data from some exotic peripheral) and, at the same time, can reach dBASE databases. Even if dBASE compatibility is not a requirement, the three libraries can be regarded as fully functional Indexed Sequential Access Method (ISAM) file managers.

The libraries reviewed are: *dBC III Plus* by Lattice Inc, *Code Base 4* by Sequiter Software Inc and *AccSys for dBASE* by Copia International. All three libraries claim to be compatible with dBASE, and it is worth pausing to consider exactly what this means.

The first condition for compatibility is that the library can read and write files that have the same internal structure as those used by dBASE. All dBASE applications use three basic types of file: database files, index files and memo files. Database files contain fixed length records that are further divided into fixed length fields. Fields can contain several different types of information; dBASE III+ supports character, numeric, date, logical and memo fields. dBASE IV introduced a sixth field type that can be used to represent floating point numbers. Conventionally, database files are identified by a .DBF file extension and are referred to as DBF files.

dBASE uses index files to order and access the information held in a database. dBASE index files are identified by the .NDX file extension. Early versions of Clipper used an incompatible type of index file identified by the .NTX extension. The Summer '87 release of Clipper introduced support for both NDX and NTX files, though not both at the same time. dBASE IV introduced multiple index (MDX) files that are able to maintain up to 47 index tags in a single file. Neither dBASE III+ nor Clipper support MDX files.

Memo fields contain references to variable length character strings stored in a separate memo file. dBASE III+ and dBASE IV use different formats for their memo files, although both types are identified by the same .DBT file extension. dBASE III+ employs a very simple approach to memos, adding new text to the DBT file and never releasing outdated text. This means that dBASE III+ memo files often grow to be very large. Thankfully, dBASE IV significantly improved its handling of memo files and space is now reused effectively. One implication of this is that, where memo fields are involved, dBASE III+ and dBASE IV are not entirely compatible.

The other compatibility prerequisite is only relevant in a multi-user or multi-tasking environment. It involves the approach taken to prevent conflicts arising from simultaneous access to database records. Provided that the library adequately supports file and record locking, compatibility is only an issue if you plan to use library functions and dBASE simultaneously to access the same files. Programming multi-user applications for networks can be difficult at the best of times - mixing file managers demands particular care.

	dBASE III+	dBASE IV	Clipper (Summer '87)	Codebase 4	dBC III Plus	AccSys for dBASE
Max no of recs in d/base file	1 billion	1 billion	1 billion	2 billion	1 billion	1 billion
Max record size (bytes)	4,000	4,000	65,536	32,666	4,000	4,000
Max no of fields in record	128	255	1,024	1,022	128	255
Max size of character field	254	254	65,535	254*	254	254

* *for dBASE compatibility. Greater for Clipper.*

Figure 1 - Product Specifications.

Common features

All three libraries implement a core of common functions: they can all create database and index files, open files, read, write and close database and memo files. All provide file and record locking mechanisms, that

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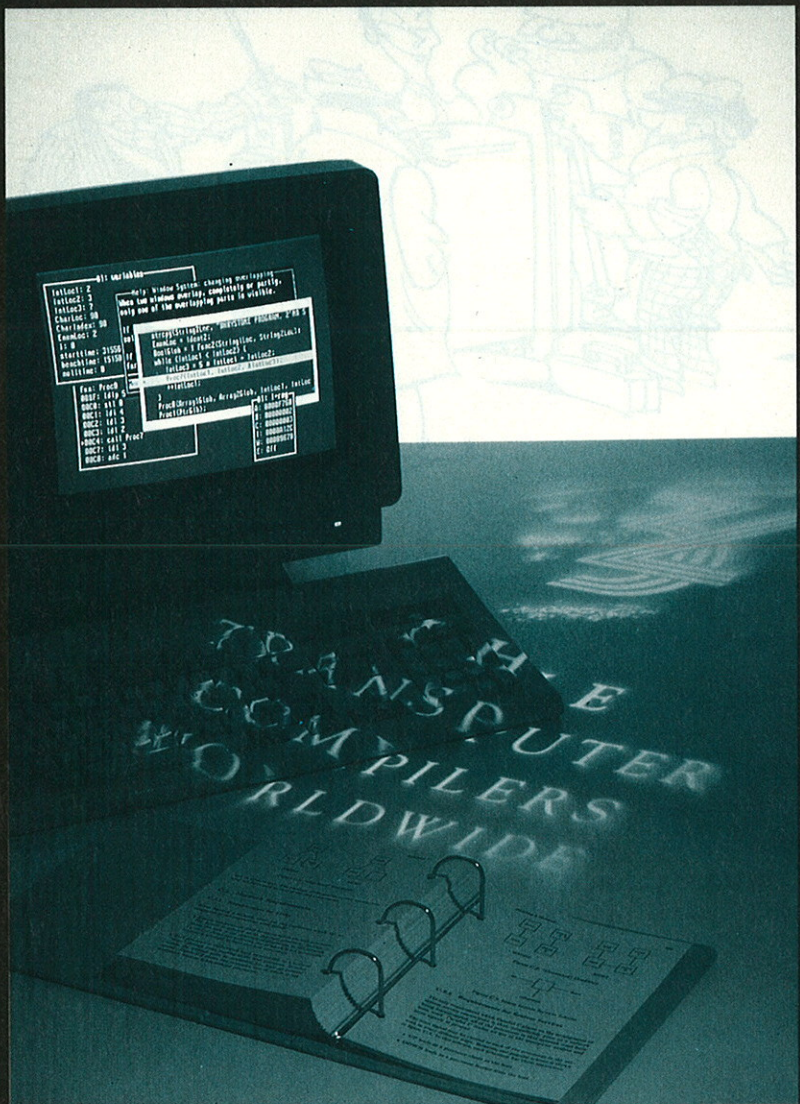

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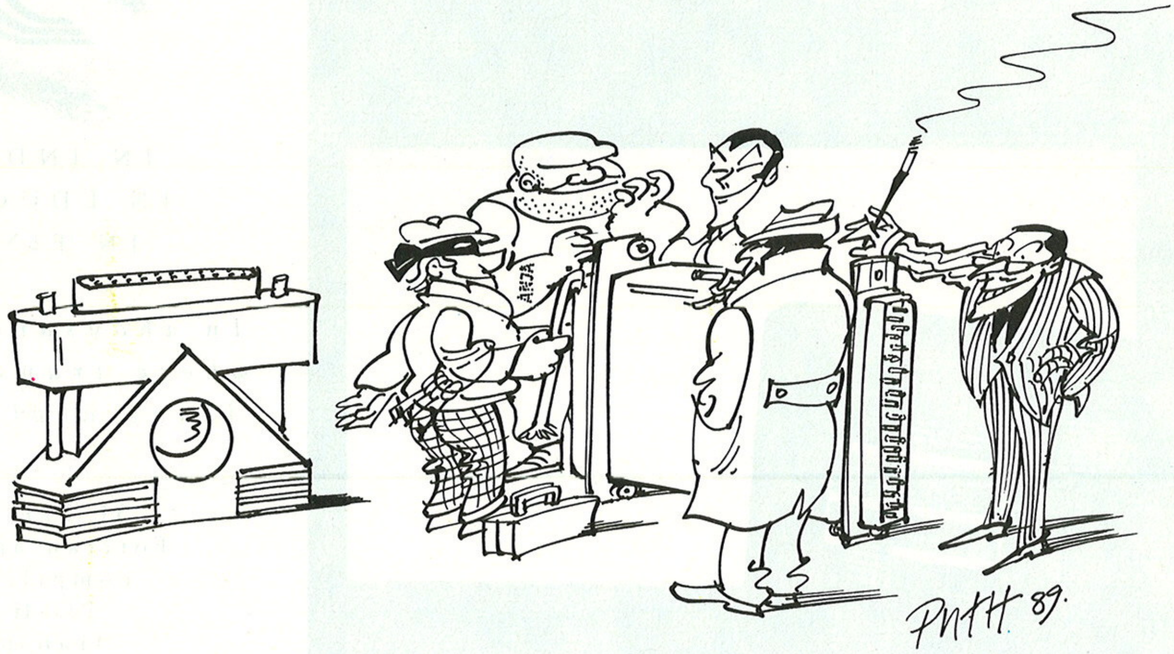

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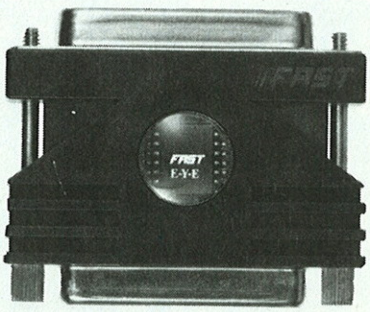

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enable you to write multi-user applications. The libraries use a different approach to accessing fields than the one supplied in the dBASE language. Under dBASE, one must select a record and then explicitly read each field as required. The libraries work by selecting a record and then reading the entire record into a buffer held in memory; individual fields may then be extracted or manipulated as necessary. Writing data follows the same principle - the memory image of the record is updated and the entire record is then written back to the database.

dBASE and C use different conventions for representing data. Strings, numbers and dates are all stored in the database as fixed length character strings. Unlike C, dBASE has no need for a null character to mark the end of the string. To overcome these, all three libraries provide a set of conversion routines that allow you to switch from one representation to the other.

Lattice dBC III Plus

dBC III Plus is a library of 61 functions compatible with files used by (surprise, surprise) dBASE III+. Users of Lattice's C compiler will already be familiar with this library, since it is the multi-user version of the dBC III library bundled with the Lattice C Development System for DOS and OS/2. dBC III Plus is sold as a separate product in its own right and is available in versions that support Microsoft and Turbo C compilers, as well as Lattice's own.

dBC III Plus's set of functions to manipulate database, index and memo files provide both power and flexibility. Note that it is possible to exploit this flexibility to create database files that are not compatible with dBASE III+, although the manual provides very explicit guidance on how to ensure that compatibility is maintained.

dBASE III+ compatibility results in a number of limitations that are not shared by the other libraries reviewed here. First, records may contain a maximum of 128 fields, compared with 255 for AccSys and 1,022 for Code Base 4. Second, memos created using dBC III Plus are limited to 4,096 characters. The library does contain a variable that specifies the maximum size of a memo field but the documentation does not specify the range of acceptable values. dBC III Plus does not support dBASE IV memo or multiple index files. Figure 1 summarises the technical specifications of the three libraries.

dBC III Plus implements a full set of file and record locking functions, and you can use it to write an OS/2 Presentation Manager application that accesses a dBASE III+ database. It is supplied with a 212 page ring-bound manual, organised into six chapters followed by appendices containing a detailed description of each function and a list of error codes. Separate chapters provide an overview of the product, a set of design guidelines, a sample application, a discussion of dBASE III+ compatibility and guidance on using dBC III Plus under OS/2. The manual is very clear and easy to read.

AccSys is the only library that supports dBASEIV's Multiple Index files

The basic price for dBC III Plus includes only the object code for the library; modules for small, compact, medium and large memory models are provided. You must specify which manufacturer's compiler you require when you order the package. If you wish to use any other compiler you will need to purchase the source code direct from Lattice.

Code Base 4

Code Base 4 (henceforth CB4) is a library of database and screen management functions that are compatible with the data files used by dBASE III+, dBASE IV and Clipper. CB4 is produced by Sequiter Software Inc of Alberta, Canada. Unlike the other libraries reviewed, CB4 provides a set of screen management functions that allow you to create windows, display menus and read data using functions similar to dBASE's `GET` routines. This additional functionality means that the combination of CB4 and a C compiler can be regarded as a full replacement for dBASE and Clipper.

CB4's database functions all correspond to real dBASE commands. They allow the programmer to create and maintain database, index and memo files. The library supports both the dBASE NDX and Clipper NTX formats for index files; there is no support for dBASE IV's multiple index files. Records have a maximum size of 32,666 bytes and may contain up to 1,022 fields. CB4 allows you to perform the standard operations to define and build index files in addition to providing access to lower-level routines.

There are two distinct sets of functions for accessing memo files. The first supports the memo file format used by dBASE III, dBASE III + and Clipper, the second is compatible with the memo file format used by dBASE IV. Both provide the same functionality. The key difference between them is that the dBASE IV routines will recover disk space when writing memo file information. There is also a call that allows you to convert dBASE III memo files into dBASE IV format. Memos may contain up to 32,767 characters.

CB4 also provides a memo edit routine that works by copying the memo to an external file, invoking a user specified external text editor to edit the file, and then copying the file back into the memo field. CB4 does not implement the word-processing features of Clipper's `MEMOEDIT` function, nor does it attempt to provide any of the supporting functions such as `MEMOLINE` and `MLCOUNT` (neither do the other libraries). Programmers moving from Clipper to C will miss this functionality, but C loyalists will be pleased with the simplicity and turn to their favourite libraries for help.

`GET` commands are emulated. Data entry fields are placed using a series of get 'commands' and activated by issuing a read 'command'. The operator may tab backwards and forwards between fields thus created, and there are facilities for picture templates and simple validation of entered data. Some set of pre- and post-modifier routines allow you to specify the attributes, associate a message and define a template for an area. Finally, CB4 also supports pop-up, pull-down, vertical, horizontal and Lotus style menus. I doubt that many C programmers will be tempted to abandon their favourite I/O libraries to use CB4's. However, these facilities will be handy for dBASE/Clipper aficionados making the transition.

CB4 implements a set of file and record locking functions for use in an OS/2 or network environment. CB4 uses a record locking strategy that is compatible with Clipper.

The standard package contains all the library source code. The bulk of it is written in C, with one assembly language module. The library explicitly supports Microsoft C, QuickC and Turbo C and contains pre-compiled library modules for each of these compilers. The source code contains several compilation `#define` switches that allow you to build libraries that are compatible with OS/2 and Windows, and that use Clipper NTX files. Another removes all refer-

ences to the screen management routines, so you can use a separate I/O library if required. Finally, there is a switch that allows you to create applications using very small executable files - provided that you do not use index files.

CB4 is supplied on four 5.25" diskettes, with a 213 page spiral-bound manual. The manual is clear, but should do more to present an overview of programming using CB4. In addition to the library source and object code, several example programs are included. No royalty payments are required when you distribute DOS or OS/2 executable programs that incorporate CB4 routines. A version of CB4 is available for UNIX/XENIX environments.

AccSys for dBASE

AccSys for dBASE contains 120 functions, compatible with both dBASE III+ and dBASE IV. It is the only library reviewed here that supports dBASE IV's Multiple Index (MDX) files. AccSys for dBASE is produced by Copia International, and is part of a family of libraries designed to permit access to the files used by popular database management programs. AccSys for dBASE is available in both single-user and multi-user forms; I looked at V1.0 of the multi-user version.

I doubt that many C programmers will be tempted to abandon their favourite I/O libraries to use CB4's

AccSys contains an extensive set of functions for manipulating database and index files. Databases created using AccSys have specifications identical to dBASE IV: each database may contain up to one billion records and each record may contain up to 255 fields, limited by a maximum record size of 4,000 bytes. The AccSys package includes a separate file, ACCSYSD.EXE, which must be available at run time, as it is used by sorting and indexing functions.

There is a comprehensive selection of functions for manipulating memo files in both dBASE III+ and dBASE IV format. These let you to create, open, close, read, write and add text to memo files. You may elect to retrieve selected parts of the memo field, starting at any point in the field. Like CB4, AccSys does not support the sophisticated editing functions available in Clipper; for this purpose you must use a text handling library or develop your own routines.

This being the multi-user version of AccSys, there are naturally some file and record locking functions. Files may be opened in either general or read-only shared mode. General shared mode allows any user to read, update or append records in files. This mode is entirely compatible with dBASE; code written using AccSys for dBASE can coexist with bona fide dBASE III+ or dBASE IV applications. Read-only

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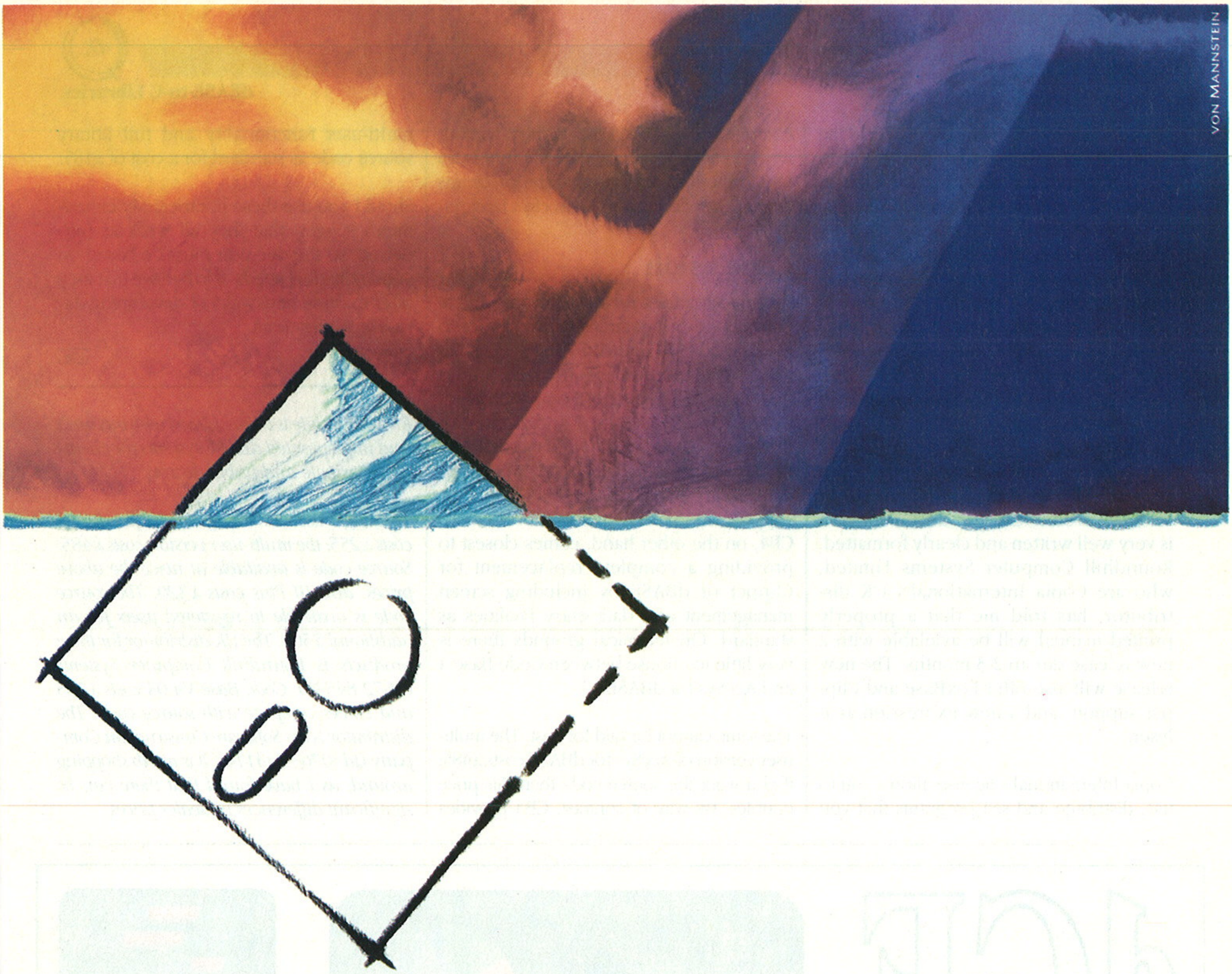

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shared mode allows many users to read the database, but only one to update it. This is more efficient than general shared mode, but not fully compatible with dBASE.

AccSys is supplied in object form, so you must specify which compiler you will use when ordering the package. The source code for the library is available at twice the cost of the object code. AccSys comes with the source code for a sample program that allow you to experiment with the library functions.

The review copy of AccSys only had a photocopied manual bound in an A4 folder. Nevertheless, the documentation is very well written and clearly formatted. Roundhill Computer Systems Limited, who are Copia International's UK distributor, has told me that a properly printed manual will be available with a new release due in 2-3 months. The new release will also offer FoxBase and Clipper support, and a new expression analyser.

Copia International's license allows you to use, distribute and sell programs that you compile using the AccSys Library without any additional licence or fees. There is no requirement to indicate that the programs were developed using the AccSys Library.

Conclusion

All three libraries reviewed in this article provide the programmer with facilities to manage dBASE files. dBC III Plus is a solid library that performs quite well, but is limited in that it is only compatible with dBASE III+. Code Base 4 and AccSys for dBASE support both dBASE III+ and dBASE IV files. AccSys for dBASE is the most up-to date library in that it is the only one to support dBASE IV's multiple index files. CB4, on the other hand, comes closest to providing a complete replacement for Clipper or dBASE by including screen management and data entry facilities as standard. On technical grounds there is very little to choose between Code Base 4 and AccSys for dBASE.

The same cannot be said for cost. The multi-user version of AccSys for dBASE costs £485; if you want the source code then this price doubles. By way of contrast, CB4 provides multi-user functionality and full library source code as standard for a cost of £185.

Should you use these libraries? My experiments suggest that they all work as purported, so the decision must be based on your individual needs. I do believe that they offer exciting new ways of developing database applications.

EXE

Russell Craigie is a consultant who has built and implemented dBASE systems for clients in the private and public sectors.

The single user version of AccSys for dBASE costs £255; the multi-user version costs £485. Source code is available at twice the above prices. dBC III Plus costs £320. The source code is available to registered users for an additional $500. The UK distributor for these products is Roundhill Computer Systems (0672 84535). Code Base V4.03 costs £185 and comes complete with source code. The distributor is the Software Construction Company Ltd (0763 244114). It is worth shopping around, as I have found that there can be significant differences in dealer prices.

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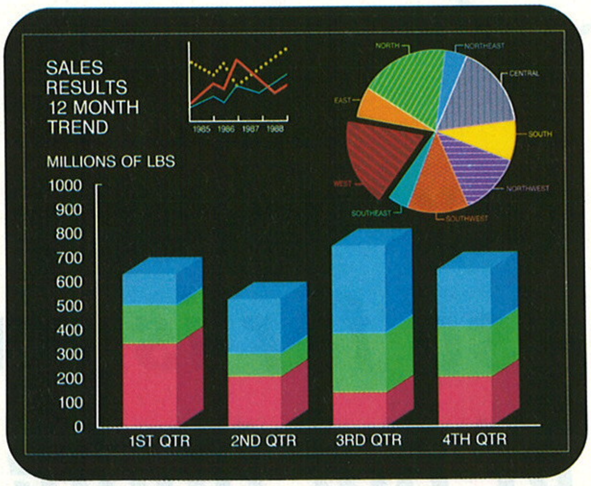

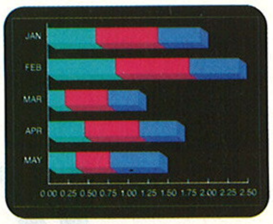

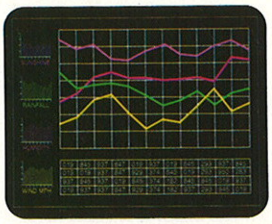

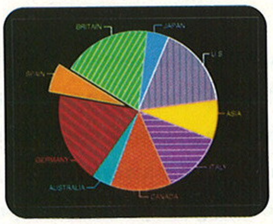

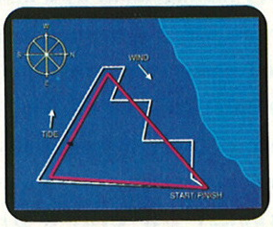

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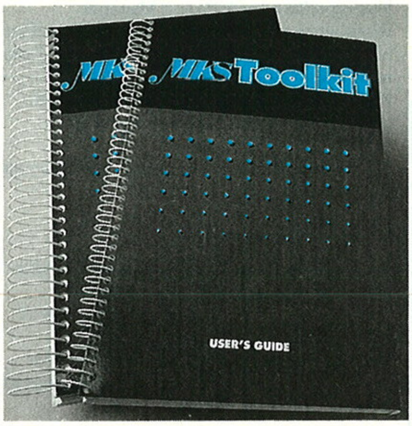

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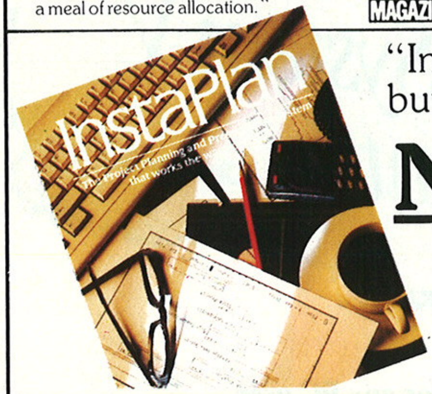

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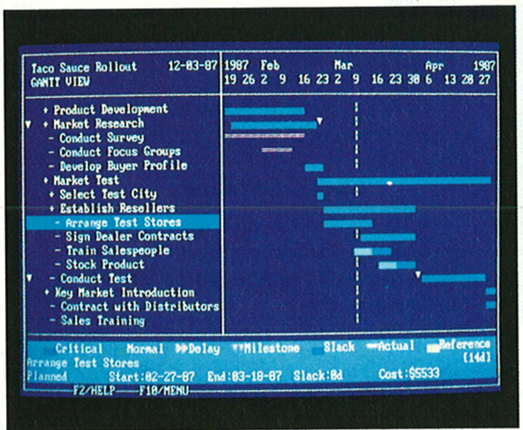

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CIRCLE NO. 138

Driving Clipper to abstraction

One of the big drawbacks of the Clipper language is the curious set of scoping rules. Mike Hart suggests a small suite of C programs, with just a hint of OOP, as a remedy.

Data abstraction (or 'encapsulation') is one of the most important components of the object-oriented approach to programming. Although the Clipper language supports some of the features of the earlier structured programming revolution, it lacks any facilities to support OOP. Even worse, the sloppy scoping rules positively hinder it.

Objects

To see why this is, we must once more go over the definition of an object. An object has a state, usually implemented as a data structure of some sort, and a number of associated functions ('methods') which can manipulate it. The state of the object must be maintained between calls to these functions.

A familiar example is the common or garden disk file. In C, for instance, there is a fixed set of I/O library functions which offer a consistent interface to the programmer. Implementation details vary between machines and operating systems. The programmer, however, only 'sees' the file through this set of functions. This arrangement hides the structures used to implement the file, which can be changed as required without affecting the client programs. It also 'modularises' the file system: if you do need to make changes, you know where to go to make them and it does not affect other parts of the program.

Data structures are protected, since they cannot be altered, except by the designated functions - hence the integrity of the object is guaranteed. Finally, the 'plug in' separateness offers the possibility of reusable software. General purpose objects can be built and used in many different situations.

This hiding and protection of program structures is called Data Abstraction and the objects so created Abstract Data Types (ADTs). I will refer to ADTs as 'objects', although strictly speaking they are not, because they do not have the property of inheritance, demanded by most definitions of OOP. The creation of objects with the property of inheritance is beyond the scope of this article. Those who complain of abuse of the term 'object-oriented' in this context should note my defence: the code presented here makes it easier (if not easy) to use an object-oriented design method; after all, the design technique should work whatever the qualities of the target language.

Design for objects

In order to build programs with objects, we need a new design approach. In functional decomposition, the design proceeds by 'divide and conquer', dividing the problem into ever more manageable functions. Object-oriented design, on the other hand, requires the identification of real world entities (OOP's simulation roots showing here) plus the actions associated with them. The objects so discovered may themselves be further subdivided. Often the low-level objects are general purpose services for client programs: items such as stacks and queues.

Programs designed in this way exhibit the advantages described above. The modules are generally less coupled and are easier to change. Also, it is usually the case that the more closely your program structures model their real world counterparts, the more likely it is that the impact of change can be minimised, or at least be analogous in size to the real world changes being modelled.

The Clipper Extend system

Clipper includes an interface to C, allowing C functions to be called from your Clipper programs. Since Clipper was written in Microsoft C V5.1, you will save yourself much grief by so using this version of C when linking to Clipper.

The C interface is specified in two header files, NANDEF.H and EXTEND.H, which must be `#included` in your C source files. These files contain macros, constants and function prototypes which allow you to pass parameters to and from Clipper, which uses non-standard conventions for passing and returning arguments. All the C functions called from Clipper must be declared as type `CLIPPER` and have no arguments.

To determine the number of parameters passed from Clipper, the macro `PCOUNT` is used. There are a set of macros to test the type of a parameter, for example `ISNUM()` and `ISCHAR()`. These macros take the parameter number, as read left to right in the Clipper source, as their argument. The parameter values are obtained by the `_par...()` family of functions - there is a different one for each supported type. In my code, integer parameters are captured with `_parni()`, longs with `_parnl()` and strings (characters) with `_parc()`. Returns to Clipper are achieved via the similar `_ret...()` functions: `_ret()` returns nothing, `_retni()` returns an `int`, `_retnl()` a `long` and `_retc()` a pointer to `char`.

This interface is a bit limited. For example, there is no mechanism for integer parameters to be passed by reference. This is why the `st_put/st_get` functions only pass one value at a time.

To compile the C program, the large memory model must be used and the library header information left out. This gives a compile command that looks like this:-

```
cl /AL /c /Ox /Zl statics.c
```

The resulting OBJ file can be linked into Clipper programs in the normal way, except that the /NOE flag must be used.

Clipper objects

To implement an object, we must be able to maintain the state of its structures (its instance data) between calls to the methods. There are a number of ways of doing this using the Clipper language, but they all present serious disadvantages.

The most obvious approach is to declare the data as `PUBLIC`. This is a very dangerous way to proceed, especially if the public variables are embedded in the code. One of the qualities we are striving to emulate is the protection of variables from access by unauthorised code. Declaring `PUBLIC` variables has exactly the opposite effect.

An alternative is to declare the data as `PRIVATE` to the environment which calls the 'method' functions. As you will recall, with Clipper this means that code at the declaration level and all functions below can see the data, unless further `PRIVATE` variables, with the same names, are created at some lower level. Data declared in this way ties two logically separate entities together (the application program's code and the object's code).

Worse, if you need to use more than one object in the same scope, you will have to pass all the data structures as parameters. These quickly become confusing and, because Clipper does not verify parameters at compile time, often result in run-time errors.

Finally, if you make changes which affect the data structures, you must search through the code for each occurrence of them. This is exactly the situation that objects are designed to avoid.

One last possibility is to create one carefully named `PUBLIC` variable and use it to hold all the structure values which need to be maintained. These values can be loaded into local variables when one of the allowable functions is invoked and saved just before return. The `PUBLIC` variable can be given a 'sure to be unique' name created at run-time.

This method mostly avoids the problems of using public variables. It also maintains the state of the object within the object's scope, so it shows promise. The major problem with this approach is its sluggishness - testing shows it to be hopelessly slow.

```
/* STATICS.C */

#include <malloc.h>
#include <string.h>
#include "nandef.h"
#include "extend.h"

#define NAME_MAX 12 /* names up to 11 chars */
#define NUMBER(n) (n == -1)
#define STRING(n) (n >=0)
#define NUMTYPE -1
#define EMPTY -2
#define INVALID -1

/* structure holds variables of two types supported */
struct var_rec{
 int length;  /* length -1 its a number */
 union {     /* length >=0 its a string */
  long number;
  char *string;
 } var;
};

CLIPPER st_create(void);
CLIPPER st_put(void);
CLIPPER st_get(void);
CLIPPER st_dispose(void);
char *install(long);
void name_put(char *,char *);
int search_for(int,char *,char *);
int valid_addr(struct var_rec *);
char *strdup2(char *);

/* create/initialise a new set of static variables */
CLIPPER st_create()
{
 int i,char_ctr;
 long ctr; 7* count of number of static variables */
 struct var_rec *ip,*ip2;
 char *char_ptr;
 ctr = (ISNUM(1)) ? _parnl(1):PCOUNT; /* num = array mode */
 ip = (struct var_rec *)
       malloc((ctr+1)*sizeof(struct var_rec));
 for(i=0,ip2 = ip;i<=ctr;i++,ip2++) ip2->length = EMPTY;
 ip->length = ctr; /* 1st record holds count of records */
ip->var.string = install(ctr);
 _retnl((long) ip);
}
/* store the names of the static variables */
char *install(long size)
{
 int i;
 char *names,*tp;
 if(ISNUM(1)) return NULL;
 names = (char *) malloc(size*NAME_MAX);
 for(i = 0,tp = names;i <PCOUNT;i++,tp+=NAME_MAX)
  name_put(tp,_parc(i+1));
 return names;
}

/* put the next name in the allocated space */
void name_put(char *dest,char *source)
{
 int i;
 for(i = 0;*source && i < NAME_MAX-1;i++)
  *dest++ = *source++;
 *dest = '\0';
}

/* put a new value in a static variable */
CLIPPER st_put()
{
 int i;
 struct var_rec *base;
 base = (struct var_rec *) _parnl(1);
 if((i = valid_addr(base)) != INVALID){
   base+=i;
  /* if you are adding a string to a string and it fits */
  if(ISCHAR(3) && STRING(base->length)
        && _parclen(3) <= base->length)
    strcpy(base->var.string,_parc(3));
  else if(STRING(base->length))
 free(base->var.string);
  if(ISCHAR(3)){
 base->length = _parclen(3);
 base->var.string = strdup2(_parc(3));
  }
  else if(ISNUM(3)){
 base->var.number = _parnl(3);
 base->length = NUMTYPE;
  }
 }
 else  _ret();
}

/* get a value from a static variable */
CLIPPER st_get()
{
 int i;
 struct var_rec *base;
 base = (struct var_rec *) _parnl(1);
 if ((i = valid_addr(base)) != INVALID){
   base+=i;
  if (STRING(base->length))
 _retc(base->var.string);
  else  /* must be number */
 _retnl(base->var.number);
 }
 else _ret();
}

/* free up the memory used by the statics */
CLIPPER st_dispose()
{
 int i;
 char c;
 struct var_rec *base,*tp;
 base = (struct var_rec *) _parnl(1);
 if(base->var.string != NULL) free(base->var.string);
 for(i=1,tp=base;i <=base->length;i++)
  if(STRING((++tp)->length)) free(tp->var.string);
 free(base);
}

/* find the offset for static variable with value 'name' */
int search_for(int size,char *nametab,char *name)
{
 int i;
 for(i=0; i < size && strcmp(nametab,name)!=0;
             nametab+=NAME_MAX,i++);
 return (i < size) ? ++i:INVALID;
}
/* check that requested offset is valid */
int valid_addr(struct var_rec *p)
{
 if(ISNUM(2) && _parni(2) >=0 && _parni(2) < p->length)
   return _parni(2)+1;

 if((p->var.string != NULL) && ISCHAR(2))
   return search_for(p->length,p->var.string,_parc(2));

 return INVALID;
}

/* Clipper does not recognise strdup so this is a replacement */
char *strdup2(char *source)
{
 char *c,*c2;
 c = (char *) malloc(strlen(source));
 strcpy(c,source);
 return c;
}
```

Figure 1 - The STATICS.C file to implement Clipper objects.

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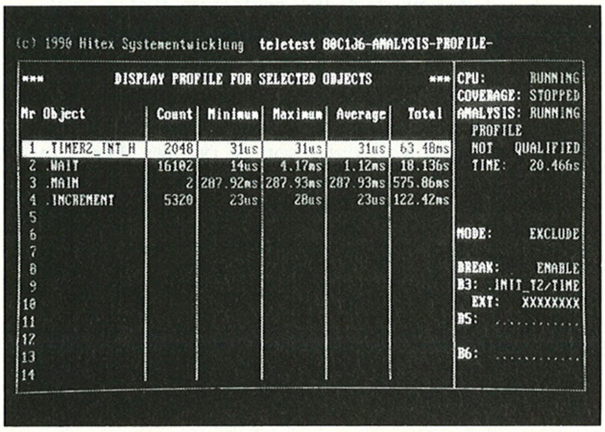

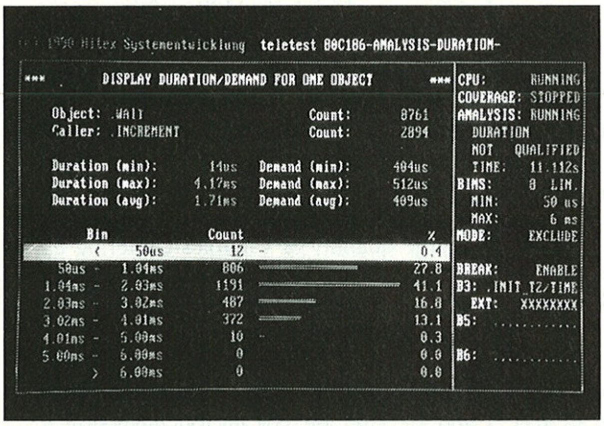

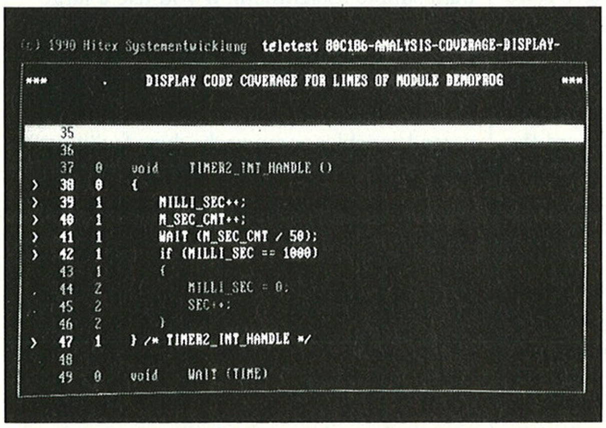

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CIRCLE NO. 139

Even the new features of Clipper 5 will not save the day. Although the new version of Clipper will have 'static' variables (which retain their value between successive calls to functions), they will be *local* statics. This still makes it difficult to implement an ADT, which usually requires multiple functions to have access to the 'static'.

Fortunately, Clipper has a bridge into C. Using the extend functions (see separate box) it is possible to create variables which maintain their values and are not prohibitively slow in use.

The functions

The idea is to borrow C's dynamic allocation to create variables which can then be accessed from Clipper. As these are dynamically allocated, they persist until freed by the programmer and can, therefore, maintain a value across calls to functions.

Time to present my library. The code for the functions is shown in Figure 1. To explain function usage, I will use the common notation of angle brackets for non terminals, the bar for OR and ellipses for repetition. The first function has the following syntax:-

```
st_create(<string exp> ...
     | <numeric exp>)
```

The function allows you to declare how many variables you want. You can either 'name' the variables by listing them as string parameters to st_create:

```
* STACKS.PRG - generic stack program
* demonstrates the use of STATICS.C

external st_create, st_put, st_get,st_dis-
pose && from statics

function stk_create
* create a new stack
parameters maxsize
private stack
  stack = st_create(maxsize+2) && extra
place for head + size
  * some check that stack <> to 0 (NULL)
here
 st_put(stack,0,2) && use pos 0 to remember
head initialise it
 st_put(stack,1,maxsize+2) && use pos 1 to
remember stack size
return stack

function push
* push an item onto the stack
parameters stack,item
private head
  head = st_get(stack,0)
  if head > st_get(stack,1)
    RETURN .F. && or possibly crash the
program
  end
  st_put(stack,head,item)
  st_put(stack,0,head+1)
RETURN .T.

function pop
* pop an item from the stack
parameters stack
private head
  head = st_get(stack,0)-1
  if head < 2  && stack proper starts at
position 2
   RETURN "" && or crash the program
  end
  st_put(stack,0,head)
RETURN st_get(stack,head)
```

Figure 2 - The STACKS program, an ADT based on STATICS.

```
object =
st_create("var1","var2","var3")
```

or you can use 'array mode':

```
object = st_create(20)
```

which creates 20 anonymous variables. If you use array mode you can only refer to variables by their offset. The first offset is '0', the next '1' etc. If you create named variables you can refer to them either by name or offset (their ordinal position in the declaration list).

Variables are stored by using

```
st_put(<object>,
     <offset | name>,<value>)
```

`<Name>` is a string expression, `<offset>` is a numeric expression, `<object>` is the value returned by `st_create`, and `<value>` is what you want to store. This may be a string expression or numeric expression. As with any normal Clipper variable, the type of value is not fixed so, even if you have used a particular variable as a string, you can go on to use it to store a number.

Values are retrieved using

```
<var> = st_get(<object>,
          <name | offset>)
```

parameters/returns similar to `st_put`. The functions perform a range check on offsets, and will return False if a non-matching name is passed in. If you `st_get` from a variable which has not been `st_put`, the returned value is rubbish. Finally,

```
st_dispose(<object>)
```

is provided to return the objects' memory to the heap when they are no longer required.

The example in Figure 2 shows how the set of functions can be used to create an ADT, in this case a stack. Notice that there is no need to declare any structures outside of the ADT. To create a stack, call `stk_create(digit)`, where `digit` allows you to specify the maximum size of the stack. (It would have been possible to store the statics as a linked list, and so create a variable length stack. However, I have shown a simpler fixed-size stack for the sake of clarity and brevity.)

The `stk_create` function returns a pointer to the new stack object. This pointer must be used to access individual items on the stack - it serves as a means of distinguishing a particular instantiation of the stack. As a result, it is possible to create as many stack objects as required. The `push` and `pop` functions work as expected.

Criteria met?

The library of routines discussed above do provide the required modularity. If we need to alter the internal workings of the stack presented in the example, there would be no need to look outside the STACKS file. The structure of the ADT is hidden from clients. The stack is an example of a reusable library module, and, most important of all, it allows the creation of something near enough to an object to ease the use of object-oriented design.

But we lack the protection that a 'real', language-supported, ADT would offer. There is no concept of 'type' in Clipper, so it is not possible to distinguish the object pointer from an ordinary integer, far less from a different sort of pointer. You can cheerfully perform arithmetic on the pointer without a squeak from Clipper - until you try to use it as a pointer again. The only protection that we have is the scope of the pointer, which is restricted to the client program.

Things would be much better if we could protect the returned pointer from change, and also plug the other main gap in the defences, which is the ability of the user to manipulate objects by calling `st_put` and `st_get` directly, instead of via 'allowable' functions such as `push` and `pop`. For the time being, we must depend upon good programming style and a sensible attitude from the user. We have, I believe, a better level of protection than achieved by using a large quantity of variables cluttering up the client program, waiting to be assigned values inadvertently, or passed in the wrong place in the parameter list.

There is, of course, a speed penalty. `st_get` and `st_put` are typically four times slower than simple assignment. If you use a large number (20 or more) of named variables, and access them by name, this rises to about four and a half times. It is possible to write a streamlined version of STATICS.C (no named variables or range checking facilities) but this produces timings only about three and a half times slower so probably does not justify the extra risk and inconvenience

Conclusion

The STATICS functions do not have the total security that we would like from an abstract data type, but they offer higher security than other methods. Program modularisation is also improved. There is a trade-off of speed against design benefits, but the overhead is not prohibitive.

EXE

Mike Hart has a degree in computer science from the Polytechnic of Central London and is now an independent consultant.

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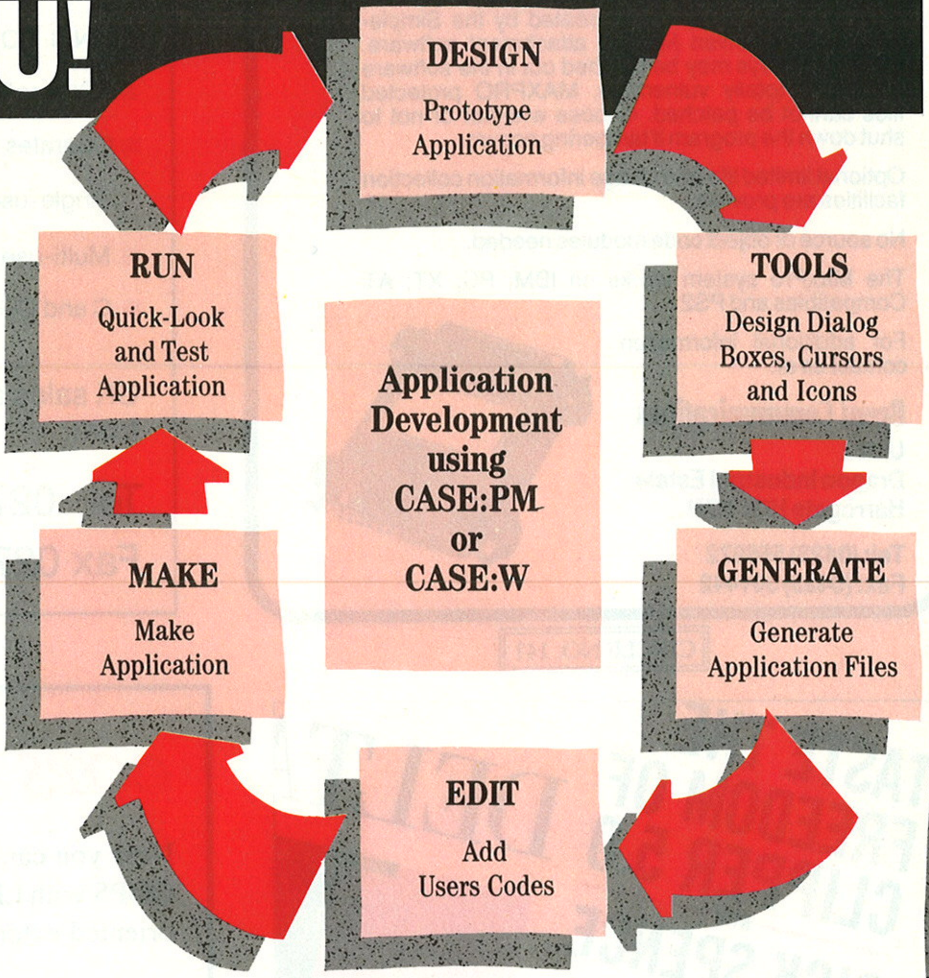

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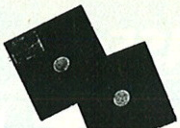

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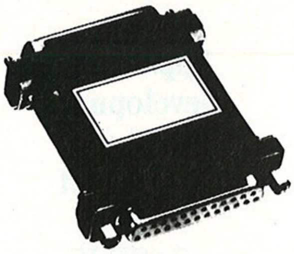

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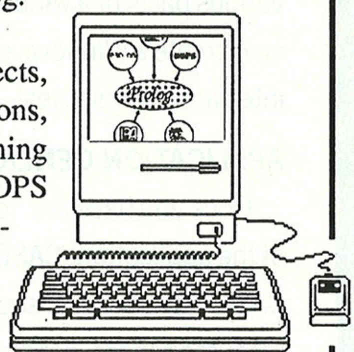

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CIRCLE NO. 144

A linker called Blinker

Blink Inc's Blinker linker has already impressed the Clipper world - with its name! But does it herald a new, carefree era for RAM-caged developers? James Ormrod investigates.

Linking has long been a source of discontent among Clipper developers. The early announcement of Clipper 5.0, to be bundled with Pocketsoft's .RTLink, has served to heighten awareness and introduce the concept of dynamic overlays to developers. With the demand so skilfully created, all that was needed was a supply. Blinker got to market first and has thus been able to take advantage of this demand. But is it any good?

Static vs dynamic

Remember how it was with PLINK86? Your application grew and grew, it ATE memory faster than Donald Trump's overdraft eats emergency supplementary loans. You avoided the issue as long as possible, but sooner or later those `MEMOEDIT()`s and `DBEDIT()`s started to crash. Of course, they didn't crash all the time, just now and again, usually in the presence of the Customer. So you resigned yourself to overlays. Static overlays, as implemented by PLINK86, force the developer to identify mutually exclusive chunks of code, compiling them into separate object modules. These modules are combined into overlay units; the smallest overlay is a single object module. Space is reserved for overlays in the .EXE program file based on the size of the largest overlay unit or maximum combination of nested overlays. When code within an overlay is called, the overlay manager loads the appropriate overlay unit into the reserved space and passes control to it. If code in the overlay references symbols within other overlay units the results can be unpredictable (=fatal). The size of the buffer reserved for loading overlays is fixed by the size of the largest overlay unit, so static overlays waste memory unless all the units are the same size.

Contrast this with Blinker's system of overlays. The dynamic overlays used by Blinker work at the procedural level, each individual procedure and function being treated as an overlay unit. Each overlay unit is treated as if it has the potential to call every other unit, the Blinker overlay manager resolving external dependencies from a fix-up table stored within it. Dynamic overlays are loaded into a resizable overlay pool within Clipper's free pool, using the minimum amount of memory. When the application is run, the overlay manager loads overlays into the overlay pool in the order in which they are called. When the overlay pool is full, a request to load another overlay causes the manager either to discard overlays on a least-used/oldest basis, or, if all current overlays are actively in use, to increase the size of the overlay pool. The technique transfers the burden of dealing with overlays from the programmer to the software, where it belongs.

Figures 2-4 show example memory maps for 'straight' (non-overlaid), static overlaid and dynamic overlaid versions of an application. I suggest that if you are unfamiliar with overlays, you take a quick squint at these to clarify what goes on inside the machine when a Clipper application is loaded.

The package

Blinker V1.11 is supplied on single disk containing BLINKER.EXE (the linker itself), BLINKER.NG (Norton Guide help - *you* supply the Norton Guide engine), the usual last minute additions to the manual READ.ME and source code for an error system and a sample profiler function. Installation is left to the user, on the assumption that a developer should be able to cope with the MS-DOS COPY command.

The manual is a slim (100 page) A5 ring binder that contains all you need to know, even if you sometimes have to hunt for it. The layout is intended to make it usable as both a tutorial and a reference manual (you are encouraged to read it straight through before you start using Blinker), although it succeeds more in the former and could do with a quick reference section. There is considerably more to Blinker than most other linkers, but still not really enough to warrant a Norton Guide, and the one supplied is not fully cross-referenced.

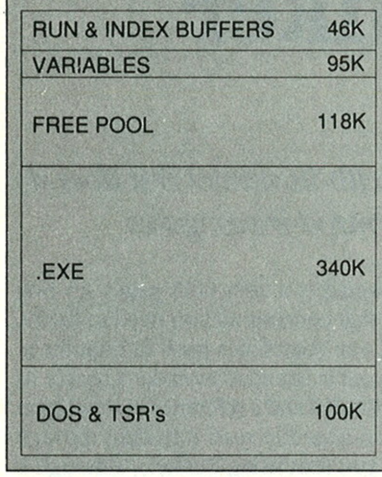
Blinker can be used to perform a 'straight' link, without creating any overlays. In practice, this is a perverse thing to do, as the resulting .EXE file will carry the 5 KB overhead of the overlay manager without using it. In order to build overlays, Blinker needs to be told which routines to place in the permanently resident .EXE root, and which should be dynamically allocated. This information is supplied in a script file, which usually has a .LNK extension.

Blinker script files are similar to PLINK86's (most Blinker command syntax is compatible with PLINK86). Blinker makes two passes through each file, processing all FILE commands on the first pass and everything else on the second. You cannot nest script files, but Blinker allows you to specify more than one on the command line, a feature that could be useful when creating different versions of an application.

```
FILE MENU                  # The root module
LIB ASM_LIB                # Cannot ALLOCATE, calls interrupts
BEGINAREA
  FILE MAINTAIN            # Overlaid Clipper code is all lumped
  FILE REPORTS             # together with no nesting required.
  FILE HOUSEKEEP
  ALLOCATE EXTEND          # Well behaved add-on libraries,
  ALLOCATE MYLIB           # including user-defined and C/ASM
  ALLOCATE C_LIB           # libraries can be overlaid.
ENDAREA
LIB CLIPPER                # Last to correctly resolve duplicates
```

Figure 1 - Typical Blinker script file.

Notes:
EXE load module includes string literals in the source code as well as a separate symbol table for each component OBJ file. You can reduce the load requirements by rationalising strings (replace `"-----"` with `REPLICATE("-",5)` etc) and compiling all source into a single OBJ.
The free pool is used for manipulating data and is the area that suffers from fragmentation. String and array data is stored here and macros extensively will manipulate them within the pool (`DBEDIT()` for example).

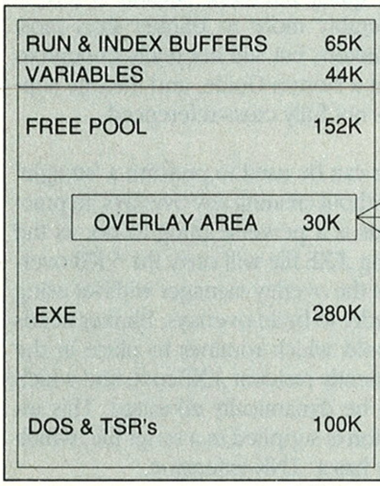


Each variable has a 22 byte entry reserved for it, consisting of its name and either its data or a pointer to its data.
The RUN and index buffer area is used in building indexes and loading a DOS COMMAND shell when the RUN (or !) command is issued.
You can claw back some memory with the SET CLIPPER environment variable, reducing the RUN area to 16KB, for example, will slow down index operations but release an extra 30KB, which will be added to the Free Pool.

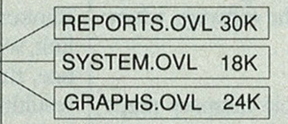
Calculations:

640KB - 100KB	DOS & TSR's (typical)
540KB - 340KB	reported EXE load size
200KB - 24KB	initial free pool size
176KB 176*20%	memory variables (35KB)
141KB - 141*33%	RUN/index buffers (46KB)
94KB + 24KB	final free pool (118KB)

Figure 2 - Clipper memory allocation, no overlays.



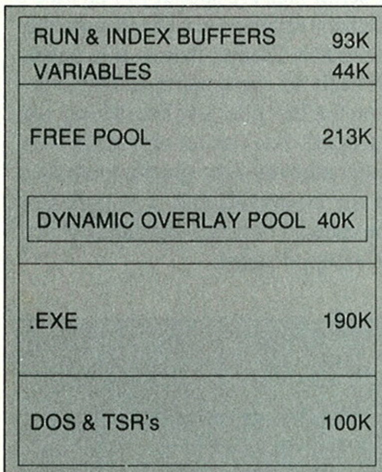
Notes:
The largest overlay dictates the size of the overlay swap area. Internal overlays are slightly more efficient. They are tacked onto the bottom of the EXE file instead of existing as separate disk OVLs.



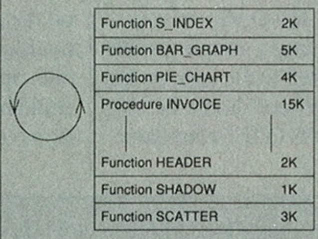
Calculations:

640KB - 100KB	DOS & TSR's (typical)
540KB - 280KB	reported EXE load size
260KB - 24KB	initial free pool size
236KB - 236*20%	memory variables (44KB max)
192KB - 192*33%	RUN/index buffers (63KB)
128KB + 24KB	final free pool (152KB)

Figure 3 - Static Overlays.



Notes:
Every function and procedure is treated as a separate overlay unit and loaded or discarded dynamically as the program executes. The overlay pool is reserved by BLINKER and can be altered. You can still use SET CLIPPER to expand the free pool; in this example we could claw back an additional 99K! (16KB for RUN/index saves 77KB while 22KB from the variables area still leaves enough for 1024 variables, which is plenty).



Calculations:

640KB - 100KB	DOS & TSR's (typical)	326KB - 44KB	memory variables (44KB max.)
540KB - 190KB	reported EXE load size	282KB - 282*33%	RUN/index buffers (93KB)
350KB - 24KB	initial free pool size	189KB + 24KB	final free pool (213KB)

Figure 4 - Dynamic Overlays.

Figure 1 shows a sample Blinker script file. The `BEGINAREA..ENDAREA` structure identifies the overlay code, note the `ALLOCATE EXTEND` command which overlays the Clipper `EXTEND` library. Root code is identified outside the overlay area, with the entry module specified first. Code that cannot be overlaid (ASM or C code that calls interrupts, for example) and un`ALLOCATE`able third party libraries come next, CLIPPER.LIB being specified last of all. The order that libraries are linked in is important, since libraries that use other libraries must be named first, and duplicate symbols are treated on a 'first come, first served' basis. Mutually dependant libraries may have to be linked with the `SEARCH` command to resolve cross references by making multiple passes. Third party libraries cannot always be `ALLOCATE`d (for example, *Tom Rettig's Library*), Blink Inc is negotiating with library manufacturers with a view to persuading them to produce Blinker versions.

Commands

Blinker script files can also contain commands that tailor the environment. Some of the most useful (stripped of their `BLINKER` prefix) are:

- `MINUTES`, `DATE` and `CALLS`, the three `DEMONSTRATION` command functions, cause a system to crash after a specified time interval, on a certain date, or after a certain number of overlay procedure calls. This allows you to provide potential customers with crippled versions of your applications.
- `EXECUTABLE SERIAL` encrypts up to 50 characters of serial number into the .EXE program, which is then available to the system and could be displayed to the user.
- `EXECUTABLE CLIPPER` allows the developer to burn-in the Clipper environment variable, instead of having to rely on schemes which rely on tampering with the punter's AUTOEXEC.BAT.
- `MEMORY PACK 15` causes the overlay manager to defragment memory after every 15 procedure calls, clearing up after macros etc.
- `OVERLAY OPSIZE` can be used to change the default overlay pool size (40KB), to reduce disk activity or increase free memory.

On test

The best way to explain Blinker is by a working example. I list below the stages I went through in 'Blinkering' an existing application. The program in question was already overlaid with PLINK86, the overlays having been balanced and optimised for size. Figure 5 shows a table of comparisons plus listings of two script files.

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**Written by Neil Martin of the British Standards Institution (BSI) and printed in Personal Computer World June 1989, page 241.*

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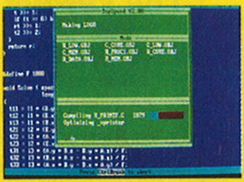

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The first test was to 'Blinker' the existing script file unchanged. The second stage was to use the `ALLOCATE` command to overlay EXTEND.LIB. The third stage involved rationalising the root module, and I decided to go the whole hog and wrote a new root module that contained a single command to call the menu system (`DO QM_MENU`) and moved everything else into the overlay area. This is just a lazy way out, since some of the old root code must always be active, and will therefore permanently occupy some of the overlay pool. The fourth stage involved compiling all the source code except the root module into a single .OBJ file, to save space in the symbol table. The final load size was down to 185 KB with the .EXE file less than 350 KB in size.

Running the resulting system proved that everything still worked, but there was much more disk activity as the overlay manager pulled overlays from the disk. To combat this, I increased the overlay pool size to 60 KB with the Blinker OVERLAY OPSIZE command. Sure enough, the disk loading overhead was reduced so that the final system was not noticeably slower than the PLINK86 version.

The finished product has a reported load size of 185 KB, or 245 KB including the 60 KB dynamic overlay pool, against PLINK86's 266 KB, which includes an 18 KB static overlay area. Blinker linked over 10 times faster than PLINK86, although some of the time made up was lost in increased compilation time producing a large OBJ file to reduce symbol space. The original PLINK86 overlays took about a day to balance and test. Converting to Blinker took a matter of minutes.

Figure 5 - Testing Blinker versus PLINK86.

Script file	PLINK86 1	Blinker 1	Blinker 2	3	4	5
Time (s)	28.12	2.86	2.74	2.69	2.63	2.63
EXE (bytes)	352496	357853	350341	361020	348396	348396
LOAD (KB)	266	252	212	196	185	185

Script file 1 (original PLINK86)

```
FI QM_MENU,QM_LIB
LIB CLIPPER,EXTEND,ASMLIB,OVERLAY
BEGINAREA
  SECTION FILE QM_GAN
  SECTION FILE QM_ADD,QM_CHK
  SECTION FILE QM_REP1,QM_REP2
  SECTION FILE QM_JDA,QM_ANA
  SECTION FILE QM_LST,QM_PROC,QM_BAN
ENDAREA
```

Script file 5 (final Blinker)

```
BLINKER OVERLAY OPSIZE 60        # Increase overlay pool to 60KB
FI QM                            # Root is just one command
LIB ASMLIB                       # Cannot ALLOCATE, interrupts
BEGINAREA
  FILE QM_ALL                    # All overlays in a single OBJ
  ALLOCATE EXTEND                # Overlay EXTEND library
ENDAREA
LIB CLIPPER
```

In profile

Blinker is supplied with a profiler, complete with full source code, that reports on the status of each overlay. The profiler can be invoked automatically each time an overlaid procedure is called, or manually through Clipper's DEBUG command or via a hotkey. The data provided by the supplied profiler consists of the name of the overlay procedure called, the time it was called, the amount of free memory (`MEMORY(0)`) after it was called, the number of times it has been called, the number of times it has been loaded from disk and the total size of all overlays currently loaded.The profiler can direct its output to a file, standard error, the printer or the screen.

Blinker provides a Programmer's interface consisting of some 25 functions. Eighteen report on some aspect of the current overlay status, the remainder allow the environment to be modified. Data available on demand includes a memory fragmentation table and the current status of demonstration settings, as well as access to the (decrypted) serial number and lots of information on the overlay pool and the procedures within it.

Functions that directly modify the environment include `BliOvlClr()`, which clears inactive overlays (freeing more Clipper pool before a memory-intensive activity), `BliMemPak()` which gets and/or sets the memory pack frequency.

`BliMemPack()` and its sister script file command, `MEMORY PACK`, overcome one of the most frustrating features of Clipper - its apparent lack of any garbage collection. There are a number of causes of memory fragmentation in Clipper: the use of macros and not closing files in the reverse of the order in which they were opened are two common ones. To test Blinker's defragmentation, I wrote a memory-junking routine that created a total of 1300 macros. Blinker's `BliDisFrg()` function, which displays a diagram representing memory fragmentation, was used to report on the state of things before and after a `BliMemPak(-1)`, which performs an immediate memory pack.

The results were impressive. True to form, memory was badly fragmented and stayed that way, even after a `CLEAR ALL`. `BliMemPak(-1)` could not quite get memory back to the condition it was in on start-up, but it came pretty close. `BliDisFrg()`, by the way, is rather clumsy to use, the table scrolling off the top of the screen at a rate of knots when a lot of memory is badly fragmented. A graph or some figures would be better, or even a straight percentage (which would allow the developer to pack memory when it had reached a certain level of fragmentation).

Blink Inc states that it is committed to expanding and enhancing Blinker. Planned over the next 12 months are support for Clipper 5.0, static overlays (for the masochist), incremental linking and storage of overlays in extended/expanded memory.

The Verdict

If you need overlays, Blinker is the one for you. It is worth bearing in mind, however, that a non-overlaid system will always be faster than an overlaid one, and you should still write tight code to avoid overlays wherever possible.

Like all great software, Blinker is based on a simple concept that has you wondering why it wasn't available years ago. A long overdue and very welcome relief for tired Clipper hacks: the next generation will wonder what all the fuss was about.

EXE

James Ormrod remembers Summer '85, and still bears the scars to prove it. He has just finished work on his 17th Clipper system and is a Nantucket Authorised Trainer. He can be contacted on (0491) 35187.

Blinker V1.11 is priced at £189.00 (free Clipper 5.0 upgrade to registered users) and is available from QBS Software Ltd. (0279) 501510.

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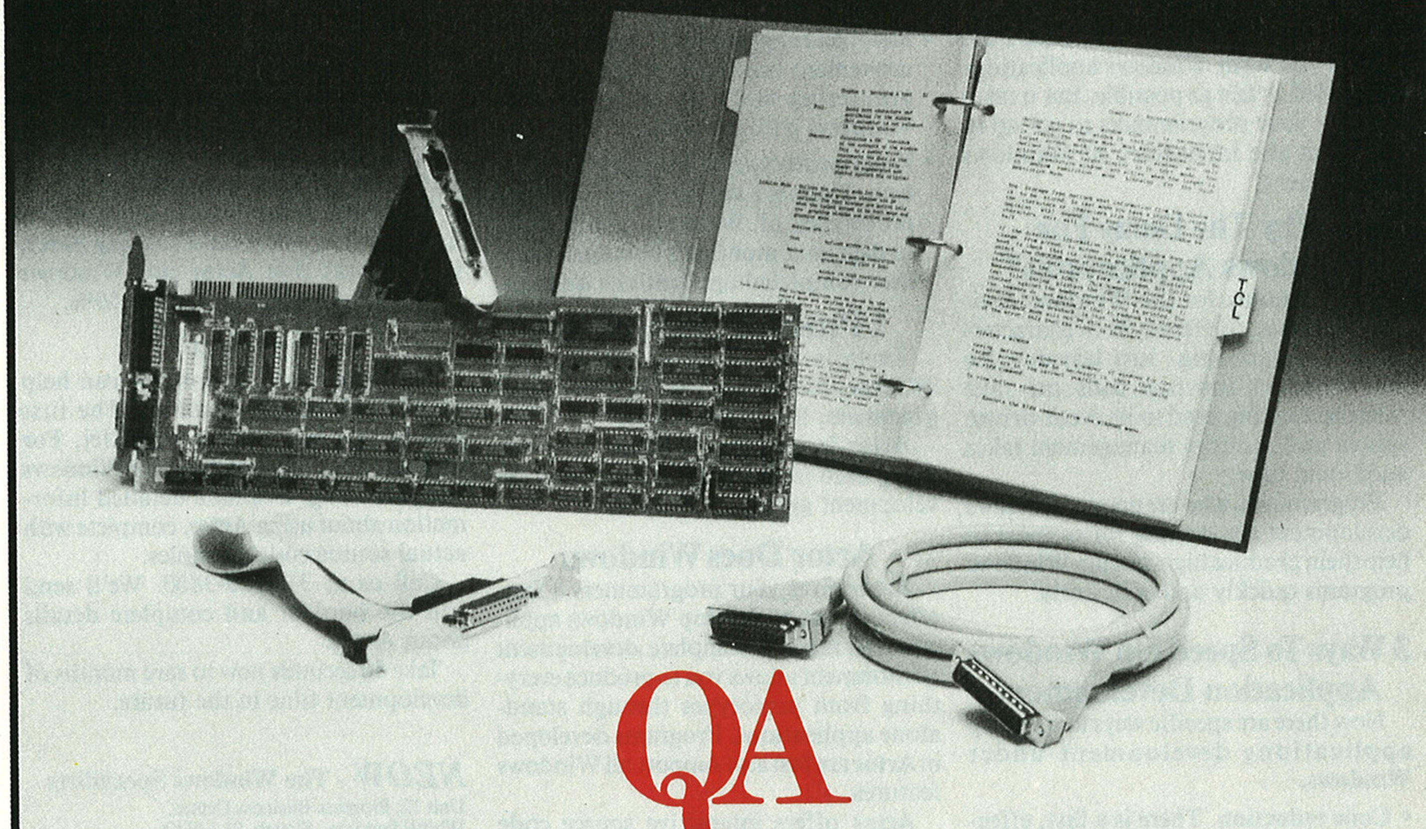

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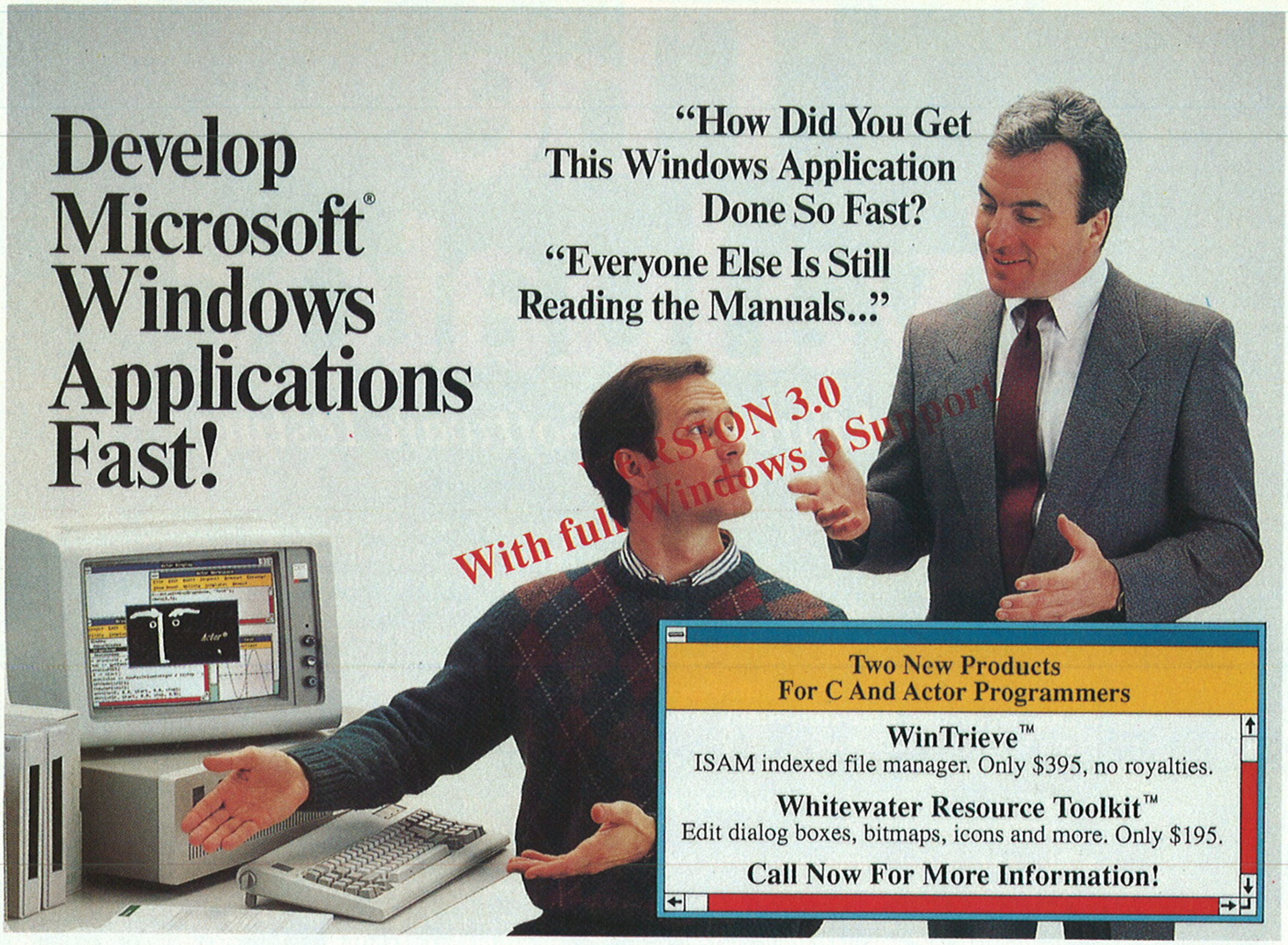

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CIRCLE NO. 147

It's not pronounced Squirrel

SQL is fast becoming the database standard. If you don't yet know how the relational model works, you will soon be dead meat: so you'd better read Jim Williams' explanation.

The 1980s was the hardware decade. In 1980, I started with 32 KB of RAM and 0.72 MB of disk storage in a Z80 North Star Horizon. By 1989, I had a 386 PC Compatible with 4 MB of RAM and 106 MB of disk storage, capable of running six jobs at once under DESQview. But as a developer of commercial applications, I am still writing the same programs: accounts, stock control, mailing lists and other systems for business users.

In this new decade, the continuing evolution of PC standards and the growth of networks emphasises the importance of connectivity of software applications. During the last few years commercial applications programmers have increasingly adopted proprietary database and 4GL products. The advantage of this approach is that reliable programs can be produced more cheaply than with the earlier 3GLs (such as BASIC and COBOL). The disadvantage is that applications become closed off to other software environments. A Sales Ledger written in dBASE would not easily combine with a stock control system written in Dataflex, except through the clumsy medium of import/export ASCII text files. When hardware dictated that applications were single-user, this drawback was not apparent. Now that PCs are being used as components of large networks, where the files of, say, the stock control department are required by accounts, this drawback becomes a serious problem.

Recognising this, the leading manufacturers are configuring their products to conform to the ANSI-defined standards of SQL (**S**tructured **Q**uery **L**anguage, generally pronounced 'sequel' not 'squirrel') and the look and feel of relational database architecture as defined by Ted Codd in 1970-72.

Database primer

There are three formally defined database models - Relational, Network and Hierarchical. The Hierarchical model is mostly of historic interest. It assumes that data may be organised in the classical directory/subdirectory structure and, if strictly followed, there can only be one forward link between a higher level of records and a lower level of records. This is not a good model of real world data. In practice, the hierarchical model tends to be compromised by duplication of data, plus some extra linkages between groups of records, to short-cut the normal search paths.

The Network model conforms better to the typical intuitive file structures that evolve in the real world. A group of invoice records may have multiple links - perhaps to the customer file and stock file - and in turn the customer file could link to the salesman/rep file. Each record type is a node, and the relationships are referred to as directed and non-directed arcs, depending on whether the linkage is one-to-one or one-to-many. The essence of the Network model is that only these two types of linkage are allowed *1->1* and *1->N*.

Relational Model

The most abstract model of database is the Relational model. The term *relational* is derived from the mathematical theory of relations which gives rise to 'relational algebra' and 'relational calculus'. The relational algebra covers the mathematical notation used to express the logic of relationships, calculus is the process of manipulating the expressions to derive more formal results.

As is usual with specialist disciplines, various terms often used in every day language have been poached and given precise meanings. An *entity* is an object with attributes. For example, an invoice is an entity, and its value is one of its attributes. Another attribute is the customer, which in turn itself has a set of attributes - name, address, credit limit and so forth. Where an attribute is an entity, then a *relationship* is said to exist. There are three types of relationship: one-to-one (*1->1*), one-to-many (*1->N*) and many-to-many (*m->n*).

A relation is depicted as a *table*, and each *column* of the table is an attribute:

```
Relation CUSTOMER:
NAME,ADDRESS,PHONE,BALANCE,SALES
MAN
```

This relation is often written as:

```
CUSTOMER(C#,NAME,ADDRESS,PHONE,B
ALANCE,SALESMAN).
```

The C# item is necessary because each *row* or *tuple* must be distinct, and must carry a unique identity which is the *primary key* - this is a stipulation of the relational model. The primary key may be artificial (such as an invoice's serial number) or natural - like a name that is known not to replicate. In a

```
1. CUSTomer = CUST(C_KEY,NAME,ADDRESS,TOWN,PHONE)
2. ITEMS bought = ITEMS(INVOICE_REF,STOCK_CODE,QTY,PRICE,C_KEY)

CUST:
[C_KEY]        [NAME]              [ADDRESS]        [TOWN]       [PHONE]
A1             ANDERSON TRADING    19 THE GROVE     CHISWICK     994-5124
B1             BARNS - SUPPLIES    20 HIGH STREET   ACTON        888-1234
C1             CARTER & SON        12 LOWER RD      ACTON        889-1234
C2             CRICKLEWOOD STORE   THE BROADWAY     CRICKLEWOOD  890-5467

ITEMS:
[INVOICE REF]  [STOCK CODE]        [DESCRIPTION]    [QTY]        [PRICE]  [C_KEY]
12333          WP1                 WHITE PAINT      10           2.90     A1
12333          BP1                 BLACK PAINT      5            3.20     A1
12333          CN                  COPPER NAILS     144          10.00    A1
12333          FB                  FLOOR BOARDS     8            16.20    A1
12334          WP1                 WHITE PAINT      8            2.32     B1
12334          BP1                 BLACK PAINT      4            2.56     B1
12335          CN                  COPPER NAILS     72           5.00     C1
12335          WP1                 WHITE PAINT      5            1.95     C1

NEW_CUST:
[C_KEY]        [NAME]              [ADDRESS]        [TOWN]       [PHONE]
A1             ANDERSON TRADING    19 THE GROVE     CHISWICK     994-5124
B2             BROWN - DIY         18 OLD STREET    NEASDEN      809-1299
C3             CARTWRIGHT BUILDER  10 DOWN LANE     EALING       778-1098
```

Figure 1 - Basic sales system.

Figure 2 - Who has not bought copper nails?

```
[C_KEY]        [NAME]               [ADDRESS]        [TOWN]        [PHONE]
B1             BARNS - SUPPLIES     20 HIGH STREET   ACTON         888-1234
C2             CRICKLEWOOD STORE    THE BROADWAY     CRICKLEWOOD   890-5467
```

table of car models, the term RENAULT 5 CAMPUS describes a particular model of car, and is unique to that make of car. Most primary keys are abbreviations derived from the name, such as RE5C.

Design

There are four stages of database design: *requirements analysis, entity relationships modelling, transformation to relations* and *normalisation of relations.*

Requirements analysis covers the stages of definition through to business systems design. In the customer sales example, at the end of requirements analysis one would expect to have identified the purpose of the system, its information content and its inputs and outputs.

Entity relationship modelling is taking the results of RA and defining the basic entities and relationships. In this case, our entities are `CUSTOMER`, `STOCK`, `INVOICE`, `ITEMS_SOLD` and `SALESMEN`. This is a crucial stage, as sound definition of entities determines how easy it is to produce a normalised final design (explained below).

Transformation to relations involves establishing the links between the newly-defined entities. We want to end up with a structure whose properties are dependent on the relationships. One property of the system is that it must print out invoices, which implies the following relationship:

```
INVOICES->CUSTOMER
  ->ITEMS_SOLD
```

We also need to report which invoices are outstanding for each customer, and what each customer has purchased:

```
CUSTOMER -> INVOICES
   -> ITEMS_SOLD
```

Each property of the system must be tested against the relationships, to establish whether the model supports the user requirements.

The above three stages may be repeated until the designers are satisfied that the model meets the functional requirement.

We are normal

Normalisation removes ambiguities from the model. There are various levels of stringency of normalisation, known as normal forms.

First Normal Form is achieved when all entities cannot be decomposed further - all attributes within a relationship are single 'atomic items'. This would debar a structure where the details of goods sold (invoice lines) and the overall accounting information such as total, due date, and salesman code are held in the same 'invoice' table. Because the sales may be decomposed to invoice lines, the invoice lines must reside in a separate table. Second Normal Form demands First Normal Form (1NF) as a prerequisite. 2NF is reached when non-prime attributes are decomposed to key fields. In our sales accounts example, the invoice might store delivery addresses. However, these delivery addresses could repeat in a sequence of invoices to the same customer. In Second Normal Form, a new table for delivery addresses is established, and the invoice table will have a field defined as the key for the delivery address.

There are up to five normal forms for relational decomposition, but in practice we need only concern ourselves with one more. Third Normal Form is the elimination of secondary dependencies with a relationship. If we stored details about the customer's credit limit and current balance in the invoice header relationship, we have a secondary dependency. This is because credit limit belongs to the customer, and is not generally related to invoice. The credit limit must be moved to a customer file (or a new table could be set up, storing the credit information for each customer).

The Relational Model & SQL

The Relational Model is based on precise notation and definition, which is also applied to the syntax of SQL. Each command in SQL mirrors an operation in relational calculus. It is this theoretical underpinning that makes possible complex extractions of information from a database using a sparse vocabulary. The following concepts from relational algebra and calculus are applicable is SQL.

Set Operation: Given tables ('A' and 'B') with similar attributes, the following set operations apply:
Union: All members of A and B eliminating duplicates. Intersection: Members of both tables.
Minus: A - B = Members of A not in B.
Selection: Select from a table those rows which satisfy one or more criteria.
Projection: Extract a set of columns from a table eliminating duplicate rows. In our sales example, the projection of customers from invoices would provide a column of customers with duplicates. The final result would not include second and subsequent occurrences of a customer ID.
Cartesian Product: The result of `A x B` ('A times B') would be a table showing all possible combinations of tuples.
Natural Join: Two tables are linked by a common attribute. A list of all invoices and customer details may be produced by a join between the customer file and invoice file, using the attribute 'customer code' as the common attribute.

SQL has the syntax for all the above five operations of relational algebra. As a result, sophisticated queries can be formulated in a surprisingly succinct manner. We shall consider the case of our sales system analysing sales data. We have two main tables, `CUST` and `ITEMS`, illustrated in Figure 1. Note these are not 2NF, as `DESCRIPTION` should live in a `STOCK CODES` file. It is included here for 'readability'. We also have a third, auxiliary file called `NEW_CUST`, also shown in Figure 1.

The core of SQL is based on the command `SELECT`, which displays attributes from a table. It takes two modifiers:

`FROM` (which defines the tables to use) and `WHERE` (specifies the conditions of selection). The results of each `SELECT` query are displayed in tabular format. `SELECT *` displays all attributes. Thus

```
SELECT *
 FROM ITEMS;
```

```
SELECT CUST.NAME, CUST.PHONE, ITEMS.DESC
FROM CUST, ITEMS
WHERE CUST.C_KEY = ITEMS.C_KEY AND
(ITEMS.STOCK_CODE = "WP1" OR ITEMS.STOCK_CODE = "BP1");

NAME                  PHONE          DESC
----                  -----          ----
ANDERSON TRADING      994-5124       WHITE PAINT
ANDERSON TRADING      994-5124       BLACK PAINT
BARNES SUPPLIES       888-1234       WHITE PAINT
BARNES SUPPLIES       888-1234       BLACK PAINT
CARTER AND SON        889 1256       WHITE PAINT

5 rows selected
```

Figure 3 - Creating a view.

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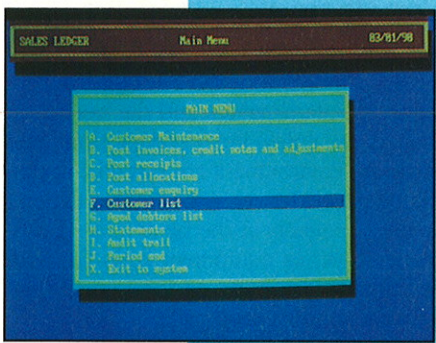

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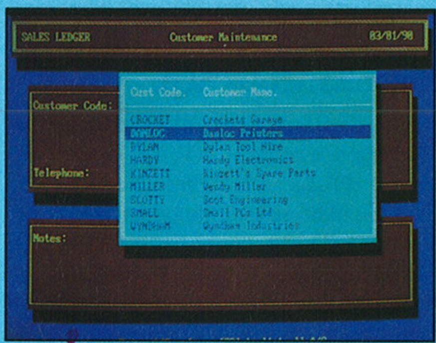

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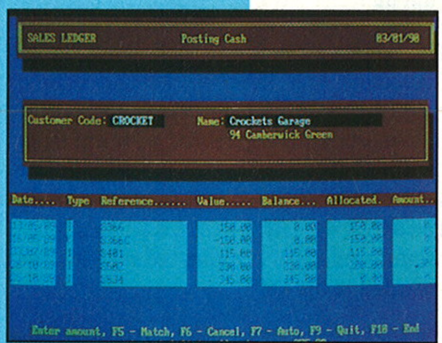

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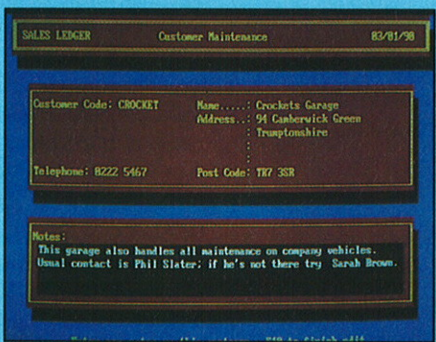

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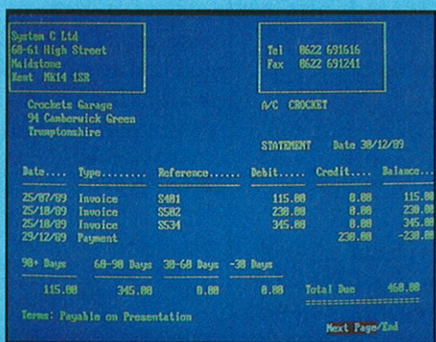

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displays all the records in `ITEMS`, and

```
SELECT ITEM.DESCRIPTION,
  ITEM.C_KEY
 FROM ITEMS
 WHERE ITEMS.C_KEY = "A1";
```

displays a table of all item descriptions and customer code where the customer key is A1. The syntax `TABLENAME.ATTRIBUTENAME` is common to most relational syntax.

Suppose we wish to have a 'join' to the customer table, to obtain the name of the customer, instead of just the key.

```
SELECT ITEM.DESCRIPTION,
  ITEM.C_KEY,
  CUST.NAME
 FROM ITEMS , CUST
 WHERE ITEMS.C_KEY = "A1"
 AND ITEMS.C_KEY = CUST.C_KEY;
```

One of the underlying mechanisms of SQL is the production of tables. Queries can be nested:

```
SELECT *
FROM CUST
WHERE C_KEY NOT IN
 (SELECT C_KEY
 FROM ITEMS
 WHERE
ITEMS.STOCK_CODE = "CN");
```

The result of the above query will list all Customers who have not bought copper nails (Figure 2). Note the use of `NOT IN` in this query. The script starts with the inner loop, creating a list of `C_KEY`s in the `ITEMS` file of purchases of copper nails. The `WHERE C_KEY NOT IN` scans this list, printing all `CUST` tuples which are not included in the list.

Qualifiers

If we wished to list all products sold at least once, then

```
SELECT DISTINCT STOCK_CODE
 FROM ITEMS;
```

would produce the following table:

```
STOCK_CODE
----------
WP1
BP1
CN
FB
```

The `DISTINCT` qualifier eliminates duplicate occurrences from the table. The `GROUP` modifier aggregates numeric fields, based on the attribute chosen for the `GROUP` clause.

```
SELECT STOCK_CODE SUM (PRICE)
FROM ITEMS
GROUP BY STOCK_CODE;
```

produces the following result:

```
STOCK_CODE       SUM(PRICE)
----------       ----------
BP1              5.76
CN               15.00
FB               16.20
WP1              7.17
```

`ORDER BY` sorts a particular column.

```
SELECT NAME PHONE
FROM CUST
ORDER BY NAME DESCENDING;
```

produces:

```
NAME                   PHONE
----                   -----
CRICKLEWOOD STORES     890-5467
CARTER AND SON         889 1256
BARNES SUPPLIES        888-1234
ANDERSON TRADING       994-5124
4 rows selected
```

Note how the descending modifier reverses the order.

An important feature of relational theory is the ability to join two tables to produce a secondary table. This derived table is described as a *view*, and given its own distinct name. Further selections may be made from the view to produce a report which combines information from two or more base tables. Figure 3 illustrates this approach, to obtain the names and phone numbers of all the customers who have bought paint.

Miscellaneous SQL

`WHERE` clauses may be constructed using the following operators: =, <>, !=, >, <, >=, <=, `IS NULL`, `IS NOT NULL` and `LIKE`. The right hand side of the operator may be either a constant or column name. Operations may be combined by means of `AND` and `OR` statements.

Figure 4 shows some other operations which can be carried out on (generally numeric-only) columns.

Figure 4 - Column operators.

Operator	Function
AVG ({DISTINCT,} COLUMN.NAME)	Mean
SUM {DISTINCT,} COLUMN.NAME	Total
COUNT {DISTINCT} COLUMN.NAME	Number of Rows
MIN (COLUMN.NAME)	Minimum Value
MAX (COLUMN.NAME)	Maximum Value

Naturally, SQL provides the means to create and update tables (although for some reason, this fundamental operation always appears towards the end of SQL tutorials). To create a table:

```
CREATE CUST (
 CODE char 2
 NAME char 20
 ADDRESS char 40
 TOWN char 20
 PHONE char 8
 ) 20;
```

where the figure following the closing bracket stipulates the number of rows to create.

The `STRUCT` command, used:

```
STRUCT CUST;
```

lists out the format established by `CREATE`. `DELETE` is used to delete either whole tables, or just selected rows specified by a `WHERE` clause. So

```
DELETE ITEMS;
```

deletes the whole `ITEMS` table, but

```
DELETE ITEMS
 WHERE
 ITEMS.STOCK_CODE = "BP1";
```

selectively deletes all rows with sales of black paint, leaving a smaller table.

`INSERT` adds extra rows to a table, and `UPDATE` changes selected rows and columns:

```
UPDATE CUST.PHONE
FROM CUST
WHERE CUST.TOWN = "ACTON";
```

affects all fields defined by the intersection of `PHONE` and `CUST.TOWN = "ACTON"` in table `CUST`. These are displayed in turn and replaced by keyboard entries. Note that the facilities for modifying tables vary slightly between implementations of SQL. Versions designed for the end user, who may not be authorised to access, say, a corporate database, may not offer any update facilities at all.

Conclusion

It is hard to understate importance of the relational model and SQL. The conceptualisation of data as tables and the notion of data as an entity independent from the hardware environment are essential in developing tools for rapid data manipulation. As my comments at the beginning of this article show, as equipment costs fall and performance increases, it is essential that software vendors keep pace.

For example, one of my clients, the MD of a medium sized company, regularly downloads his whole company database - 2,000 customers, two years sales ledger, three years back sales history and a 1000 item stock file - onto his PC. He uses this data to prepare various reports and analyses that enable him to construct his business plans from home, or even while travelling abroad. With a suitable SQL system - I use Dataflex's FLEX-QL, because I program with that company's proprietary database language products - he can treat his corporate database as a massive spreadsheet which updated once a week. He uses a copy of the same database that is directly updated as orders are entered, goods sold and new customers acquired. There is no intermediary between the real facts of his business and his need for information to control the future.

EXE

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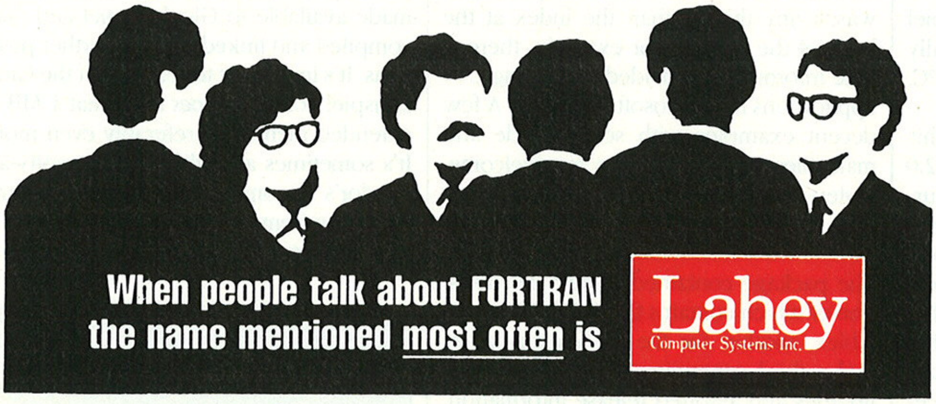

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CIRCLE NO. 150

Last of the preprocessors: Glockenspiel C++ 2.0

Dave Jewell checks out Glockenspiel's latest C++ offering and decides that all is not what it seems....

Although 'the Year that Unix Really Arrived' never seems to get here, 1990 may justly claim to be the year when C++ finally moved into the mainstream PC programming arena. Among PC programmers, Turbo C has always had a large and devoted following; the recent introduction of Turbo C++ has provided an easy upgrade path for those keen to begin exploring this new language. Last year saw the introduction of Zortech C++ 2.0 and, as I write, Zortech are about to release version 2.1 of their compiler which implements a number of previously left out features of the language and also provides support for Windows 3.

Both Zortech and Turbo C++ are native compilers. They take C++ source files as input and produce standard Microsoft format object files as output. But the first C++ compilers to arrive on the PC scene were translators. C++ translators produce C source code which then needs to be compiled using a standard C compiler. I believe I'm right in stating that the Glockenspiel C++ translator was the first commercially available implementation of C++ for the PC.

Glockenspiel C++ 2.0a, the subject of this review, is the company's latest C++ 2.0 compiler. Glockenspiel (like all other current C++ translators) is based on the standard translator developed by AT&T: *Cfront*. Version 2.0 of Cfront adds a number of new features to the C++ language. Most notable among these additions are: multiple inheritance, type-safe linkage and virtual base classes. As well as the version 2.0 enhancements to the language itself, Glockenspiel now supports the new Microsoft C 6.0 compiler and the associated PWB (Programmer's WorkBench) environment. An online help reference is also supplied. More on these later. Glockenspiel also supplies *CommonView*, a set of C++ class libraries for programming under Microsoft Windows and OS/2 PM. This may be ordered separately from Glockenspiel, and does not form a part of this review. *(From the beginning of August, Glockenspiel will bundle its C++ compiler and CommonView as one package - Ed).*

Opening the box...

The Glockenspiel documentation is contained within a single three ring binder and is divided into four parts, these being: *User Guide, Compiler Guide, Syntax Manual* and *Library Guide*. The latter two are of particular interest, since they are essentially reprints of the definitive AT&T manuals. The other documentation contains a comprehensive list of available compiler switches and other options, although I felt that the information provided here was rather minimal. The User Guide in particular wasn't any thicker than the index at the back of the binder. For example, there is little information provided on writing C++ applications for Microsoft Windows. A few decent examples with source code and make files would have been very welcome. A step-by-step tutorial would be even better.

The package contained three 5.25" disks, one of which contains the MS-DOS executables, another for the OS/2 executables and a third containing common headers, libraries and assorted release information. A set of 3.5" disks was also supplied. The installation program asked the usual sort of questions: where it should put the libraries? header files? and so on. It then installed the system painlessly. Disk space requirements are quite modest :- the MS-DOS system required less than 2 MB.

Memory Requirements

After installing Glockenspiel onto my hard disk, my intention was to begin by compiling the classic 'hello' C++ program. This masterpiece is illustrated in its entirety in Figure 1.

Unfortunately , my initial attempts to compile this program resulted in the compiler complaining about a lack of memory. Glockenspiel states that its compiler needs to run on an 80286 or 80386 system with 640 KB of base memory and a minimum of 1 MB of extended memory. Unfortunately, when I'm not running Windows, the extended memory on my machine is normally configured as a RAM cache and consequently it wasn't available to the compiler. After editing my CONFIG.SYS file and rebooting, all my extended memory was made available to Glockenspiel and *hello* compiled and linked without further problems. It's important to realise that the Glockenspiel compiler *does* need that 1 MB of extended memory, preferably even more. It's sometimes all right to take a software vendor's 'recommended' minimum hardware requirements with a pinch of salt. In this case, you shouldn't.

```
#include "iostream.hxx"

void main (void)
{
  cout << "Hello Glockenspiel....";
}
```

Figure 1 - C++ Hello program.

While on the subject of memory usage, it's interesting to note that the compiler is implemented using the Rational Systems DOS/16M Extender, and it's through this go-between that it makes use of extended memory. I've never quite figured out why it is that a typical port of the AT&T Cfront translator seems to require even more memory than a native code C++ compiler implementation, but Glockenspiel C++2.0 is no exception. Sadly, you can't make use of the Rational Extender technology from within your own software :- if you want to do that you have to buy the DOS Extender for yourself. In this respect, Borland's Turbo C++ VROOM system comes out on top because VROOM allows you to compile bigger programs (it's built into the compiler) *and* it can be used inside your own software at no extra cost. Although the new Zortech 2.1 C++ system also makes use of the same Rational Systems Extender, Zortech provide their own VCM (Virtual Code Management) technology for inclusion in your own programs. The bottom line is: when it comes to writing *big* MS-DOS based C++ programs, Borland and Zortech have done all the hard work for you; with Glockenspiel it's an optional extra.

The compiler in use

The Glockenspiel compiler is no speed demon. It chugs along happily at the sort of speed that is all too familiar to Microsoft C users. Like Microsoft, it takes a large and sometimes bewildering range of compiler switches. For convenience, commonly used compilation switches can be set up in an environment variable called **CCXX**. CCXX.EXE is also the name of the compiler 'driver' :- the small program which executes the various parts of the compiler proper, and then invokes the Microsoft C compiler and the linker to produce the finished executable program.

Broadly speaking, the command line switches fall into one of three categories: those beginning with a '!' character control the operation of the CCXX compiler driver program. These switches offer a useful range of options, including the ability to generate a list of commands which can be redirected to a batch file. For machines without much memory, this batch file can then be executed directly without the overhead of having the compiler driver in memory also.

Glockenspiel chugs along happily at the sort of speed that is all too familiar to Microsoft C users

The second category of switches is preceded with a '+' character. These switches control the operation of the C++ compiler itself. An interesting option here is the ability to generate code compatible with Microsoft C 5.1. (By default, generated code is compatible with Microsoft C 6.0.)

The final switch category starts with a '-' character. These switches control various aspects of the preprocessing and linking phases. Unrecognised switches in this category are passed through to the native code compiler. For example, you could specify '-Gsw' to instruct Microsoft C to generate Windows compatible code.

A very big surprise for me was the lack of support for anything except the large memory model. Maybe I'm missing something fundamental. I really can't understand the need for this restriction. The Glockenspiel compiler is quite capable of producing small and medium model code :- I tried a few experiments to prove it. The problem is that *only* large model libraries are provided. A total of six different large model libraries are supplied covering the various combinations of calling convention (stack-based and register-based) and 8087 support (8087 mode, emulation and alternate). Given the choice, I suspect that many potential customers users would prefer having fewer large model libraries and more of the other models! By contrast, both Zortech and Borland provide the usual range of memory models.

The Glockenspiel compiler produces C source code files with an extension of '.I'. These files are then processed by the Microsoft C compiler to produce object code. I wouldn't recommend browsing through one of these C source files unless you have a strong stomach :- they're not intended for human consumption! This isn't a reflection on the Glockenspiel implementation. Any version of Cfront produces similar output. The C code looks particularly tangled if you include and use the IOSTREAM.H header file, which contains the C++ interface for the new AT&T stream library. This is because AT&T seem to have a tendency to use `inline` member functions with great enthusiasm. The code in the IOSTREAM.HXX header contains `inline` functions which call `inline` functions which call....well, you get the idea. The example *single* C statement in Figure 2 should give you a flavour of what can happen.

Supplied Utilities

As a part of the Glockenspiel C++ package, Glockenspiel supply what looks like a complete copy of the previously mentioned *Syntax Manual* as an online reference. The help file, called CXXSYN.HLP, is a help database file in the same format as that used by both the Microsoft QuickHelp utility and the PWB help facility. Just in case you don't have the QuickHelp program (ie you are a C V5.1 owner), Glockenspiel has supplied a copy as part of the package.

Another interesting utility is a program called CXXFILT. This is a C++ name 'unmangler' which restores mangled C++ names back to a human-readable form. For those unfamiliar with the concept of C++ name mangling, it involves encoding the number and types of a function's parameters into the function name. All C++ 2.0 compilers implement 'type-safe linkage', whereby the linker is able to check that all references to a function across all object modules agree with the actual function declaration. This is achieved by name mangling, which has the big benefit that a standard linker can be used. The linker will complain about unresolved refer-

```
if ( ( ( ( __0this -> Pios-> bp__3ios -> x_pptr__9streambuf >= __0this ->
Pios-> bp__3ios -> x_epptr__9streambuf ) ?( ( * ( ( ( int ( *
) ( struct streambuf * __0this , int __1c ) ) ( __0this -> Pios->
bp__3ios -> __vptr__9streambuf [ 2] ) .f) ) ) ) ( ( ( struct
streambuf * ) ( ( ( ( char * ) __0this -> Pios-> bp__3ios )
) + ( __0this -> Pios-> bp__3ios -> __vptr__9streambuf [ 2] ) .d) )
, ((int )__0c )& 0377 ) :( ( ( ( * ( __0this -> Pios->
bp__3ios -> x_pptr__9streambuf ++ ) ) ) = ((int )__0c )) & 0377 ) )
) == -1) {
( ( ( ((struct ios * )__0this -> Pios)-> state__3ios |= ( 3& 0377 ) )
, ( ( ((struct ios * )__0this -> Pios)-> ispecial__3ios |= ( 3& ( ~
512) ) ) , ( ((struct ios * )__0this -> Pios)-> ispecial__3ios |= 3) )
) , ( ( ( char ) 0 ) ) ) ;
```

Figure 2 - A single C statement output by Glockenspiel.

ences if a type-mismatch occurs between modules. The CXXFILT program is implemented as a filter taking its input from 'stdin' and writing the results to 'stdout'. It can be used to unmangle unresolved references generated by the linker as an aid to determining what type mismatch errors have occurred. I found that, although CXXFILT worked most of the time, there were some mangled names that it refused to unmangle. For example, it had problems with constructors, destructors and with overloaded operators.

For those who like using the Microsoft PWB environment, Glockenspiel includes a PWB extension which integrates C++ into the PWB system. Files with an extension of CXX are recognised as being C++ files and the Glockenspiel compiler is automatically invoked to build the corresponding object files. Menu choices allow you to select either 'C++ Debug Options' or 'C++ Release Options' for controlling the insertion of debugging information into the object code. Support for the PWB Source Browser is also provided although for maximum readability you would have to use the !M compiler switch which disables inline function generation and minimises name mangling. The Browser doesn't understand C++ member function names.

Stop Press

Since Dave finished his review, Glockenspiel has upgraded its C++ compiler to V2.0c. We have not seen the product ourselves, but the manufacturer reports a variety of improvements. Addressing one of the criticisms of this article, a new filter program called FXX has been introduced. This processes the debug information in an executable file, 'transforming mangled C back into C++'. CodeView users can now see the correct C++ code in their local, call stack and watch windows. The PWB browser also now becomes usable at C++ source level.

Other enhancements: there is now support for creating DLLs, positioning of PWB's editor at the site of compilation errors, 31 character identifiers are allowed, 64 KB character arrays can be produced (limit up from 32 KB) plus various other tweaks and fixes.

Probably one of the most important reasons for considering Glockenspiel's C++ implementation is the tie-in with the CommonView class libraries, so it is relevant to note that a new version of CommonView, for Microsoft Windows V3.0, will be launched around the same time that this issue of .EXE is published. *Ed.*

Code Generation

Commenting on the object code quality of a C++ translator is somewhat irrelevant, since the native C compiler (in this case Microsoft C 6.0) is the real producer of the object code. Having said that, there are in fact plenty of optimisation opportunities which are available to Cfront itself and I've yet to see a version of the translator which avails itself of many of them. For example, how often can you see the construct `__0this -> Pios-> bp__3ios` in the code fragment in Figure 2?

I wouldn't recommend browsing through these C source files unless you have a strong stomach

Bearing in mind that Glockenspiel restrict users to the large memory model, this sort of thing is going to eat up a lot of code unless it's used in conjunction with a fiendishly cunning optimiser in the native C compiler. Microsoft C 6.0 isn't that cunning. Ideally, the C++ translator should set up a temporary pointer variable and use this to reference deeply indirected class members. This would be analogous to a hidden `WITH` clause in the Pascal language. Such optimisations would drastically improve the quality of the final code (both in terms of increased speed and reduced size).

Of course, major changes to Cfront such as the one I've described aren't really Glockenspiel's responsibility. AT&T are the developers of Cfront :- it's up to them to ensure that reasonable quality code will be produced even when used with the stupidest of non-optimising compilers.

Windows Support

Because you can pass command-line switches through to the Microsoft C compiler, it's easy with Glockenspiel C++ to generate code in the format needed for use under Microsoft Windows. Because the final code is produced by the new Microsoft compiler and linked with the new Microsoft Windows libraries, there are no problems regarding compatibility with Windows 3. The restriction of large model only libraries could prove to be a problem, however. The majority of non-trivial Windows programs are written to use the medium memory model.

Conformance to V2.0 C++

A major advantage of a C++ translator based on AT&T's Cfront program is the fact that it's based on an absolutely standard implementation of C++. Zortech's early C++ offerings were notoriously deficient in certain areas (the latest Zortech compiler, version 2.1, will be the first to add pointers to members) and you would be unlikely to encounter this sort of problem with Glockenspiel C++. I tried out a number of C++ 'torture tests' on the compiler and didn't encounter any problems.

Conclusions

Although suppliers of C++ translators such as Glockenspiel, Comeau and Intek, (and perhaps AT&T themselves) would undoubtedly disagree with me, I strongly feel that the days of C++ translators are now numbered, at least as far as the PC market is concerned. Zortech hammered the first nail into their coffin; Borland recently administered an even bigger nail; and Microsoft (when they eventually get round to it) will very likely supply the biggest nail of all in the shape of a native code C++ compiler and development environment which seamlessly integrates MS-DOS, Windows and OS/2 development. So what are my reasons for taking such a heretical stance?

Originally, Bjarne Stroustrup and his colleagues at AT&T took the decision to write Cfront as a translator rather than as a native code compiler for reasons of portability. It meant that C++ could be implemented relatively easily on any platform which already had a workable C compiler. Now that there are at least two native code C++ compilers for the Intel 80x86 microprocessor family, implementation portability is clearly less of an issue. Secondly, as I have already pointed out, the intermediate C code generated by a Cfront translator leaves a lot to be desired in efficiency terms. Even a reasonably good code optimiser such as that in Microsoft C is unable to take a 'higher-level' view and implement the sort of pointer optimisations I've mentioned. Lastly, the presence of a third-party native C compiler between the C++ translator and the

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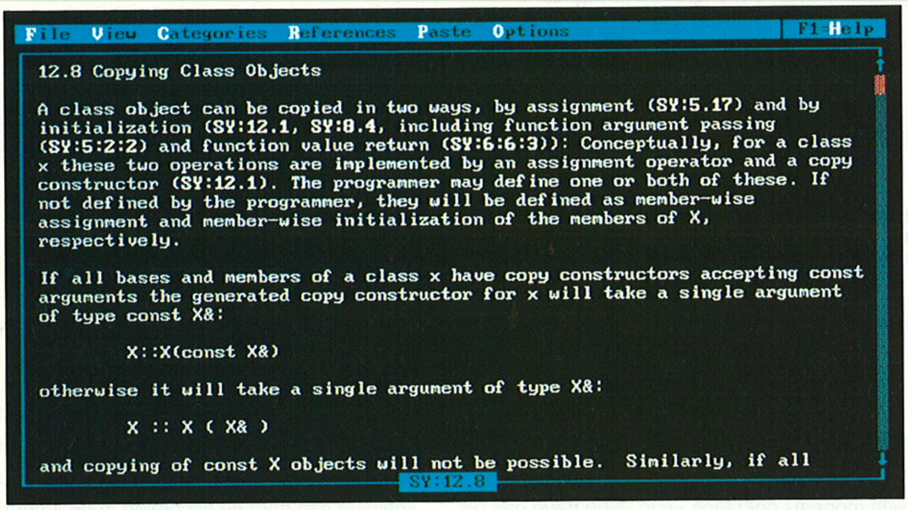
Figure 3 - Screen shot of Help database.



final object code has the effect of 'distancing' a C++ translator vendor from the end product:- the executable program. Ultimately, it will be much more difficult for a company like Glockenspiel to provide such goodies as VROOM, VCM, and fully integrated debugging support than it will be for the likes of Borland, Zortech and other prospective manufacturers of native code compilers.

Until I've had a chance to check out the new Zortech release (which claims Windows 3 compatibility) I believe that Glockenspiel is still a reasonable choice for Windows and OS/2 development, although I do have some reservations about the lack of anything except large-model support. For regular MS-DOS work, I don't feel that Glockenspiel is a serious competitor to Turbo C++.

EXE

Dave Jewell is a Senior Consultant to the SignExpress Group, Basingstoke. He can be contacted on CIX as djewell, *where he helps moderate the* windows *conference.*

Glockenspiel C++ for the PC (together with CommonView) is available from QA Training (0285 655888) priced £495. Apart from the PC version, Glockenspiel's C++ is available on an enormous variety of platforms, including the recently introduced IBM RS/6000. Details of these are obtainable directly from the manufacturer in Eire (0001 733 166).

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CIRCLE NO. 154

A Faster Way to Search Text

End 'waiting for lengthy string searches to finish' blues with the Boyer Moore algorithm! Jim Segrave introduces finesse to your text searches.

One often needs to search a text buffer for a string match. The most obvious approach - you might call it the Arnold Schwarzenegger algorithm - is to create an outer loop, which creeps through the buffer a character at a time, containing an inner loop, which compares each character of the test string with the current piece of buffer. This technique is demonstrated in the `brute_force` routine in Figure 1. The problem with it is that it must make at least one comparison for every possible starting location in the text buffer.

Boyer Moore searches make use of a very simple idea. The algorithm tries to decide if it's possible for the search pattern to occur at the current search point. If not, it skips forward to the next place in the text buffer where it might be possible.

How it works

To decide whether the search pattern might occur at the current search point, look at the character in the buffer which must match the end of the search pattern. One of three possibilities exist:

1) The character is the same as the last character of the search pattern. In this case, we will actually compare the characters beginning at search point to see if we've found a match.

2) The character is not one which is part of the search pattern - we can ignore all the characters through and including the one we just looked at, since its not possible that the search pattern can be found anywhere in the region from the search point through the character we've looked at. We move the search point forward by *search length* characters and try again, saving *search length* tests.

3) The character is not a match to the end of the search pattern, but it does occur somewhere in the search pattern. We can move the search point forward a bit, since we know that we can't find a match here. The amount we can move is determined by the position of the character we just found in the search pattern. Consider the situation with the search pattern set to `'YELLOW'`, and the character we pick up is a `'Y'`. We can move the search point forward to the `'Y'`, since any match to the pattern would have to begin at the `'Y'`. If the character appears more than once in the search pattern, we must be more careful. Suppose the character in the buffer is `'L'`. Figure 2 illustrates this situation. It is possible that `'YELLOW'` might occur at two places in the text buffer - the `'L'` might match either the first or second `'L'` in the pattern. We can only advance the search point by two characters, in case the `'L'` matches the second `'L'` of the pattern.

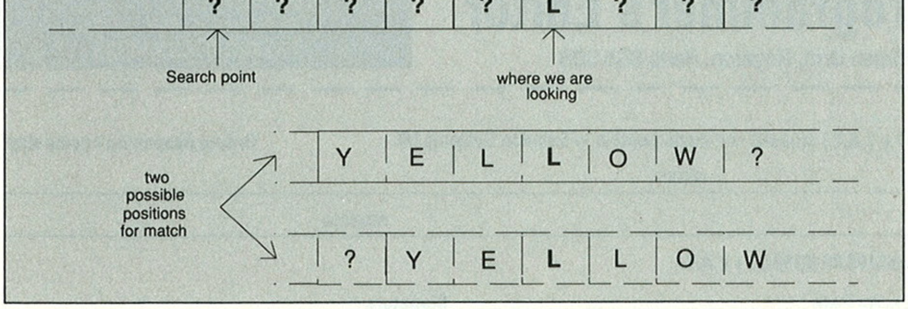

Figure 2 - Finding 'L' in the text buffer.

Figure 1 - brute_force ( ), the obvious approach.

```
char *brute_force (char *text,
                   int textlen,
                    char *search,
                    int searchlen)
  {
  char  *sp; /* current search point */
  char  *ep; /* last possible loc to try */
  int   i;

  ep = text + textlen - searchlen;
  sp = text;

  while (sp < ep)
    {
    /* the time eating inner loop */

    for (i = 0; i < searchlen; ++i)
      if (sp[i] != search[i])
        break;

    if (i == searchlen)
      return (sp);     /* found it!  */
    /* advance search point and loop  */
    ++sp;
    }

  return (NULL); /* not found...  */

  }
```

It is not very efficient to look for the character in the search pattern and calculate how far to advance the search point each time. It is far better to build a complete table of search point adjustments before we begin. For every possible character, the table will contain the number of characters to advance the search point if we find that particular character in the buffer when we look for a match for the end of the search pattern.

We initialise every entry in the table to the length of the search pattern - if a character does not appear in the search pattern, case 2 above, then we skip forward by the search length.

We then read through the search pattern, setting the table entry to *search length - offset of char in search pattern - 1.* These

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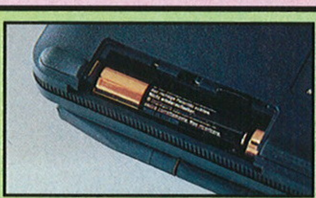

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are the values we use for case 3 above - where we find a character which isn't a match for the end of the search pattern but does occur somewhere in it. This scheme automatically handles the problem of multiple occurrences of a character in the search pattern, since the value will be rewritten as we go through the search pattern. The new value will be smaller for the second (or third or ...) occurrence of the character in the search pattern.

For the search on 'YELLOW' above, this means that `table['Y']` would become 5 (= *search length - 1*), `table['E']` would be 4, `table['L']` would be set first to 3 and then to 2, and `table['O']` would be set to 1. All remaining characters take the value 6.

The final character of the search pattern wants special handling. If we just use the method in the previous paragraphs, we would write a zero in the table for this character. That's fine, the zero tells us that it is worth actually examining the buffer at the search point for the search pattern, but it doesn't tell us what to do if we don't find the pattern there. We need save the current table value before setting it to zero. We'll use this saved value to decide where to go when, after finding the last character of the pattern in the right place, we discover that we haven't got a match.

For example: if the search pattern is `'BELLE'`, when we find an `'E'` at search point +4, `table['E']` will be zero and we go off and check for `'BELL'`. If we don't find it, we should move the search point forward 3 characters, since the `'E'` we were looking at could be a match to the second character of the search pattern rather than the last.

```
char *boyer_moore (char *text, int textlen, char *search, int searchlen)
  {
  int   table[256];      /* assuming 8 bit characters    */
  int   lastjmp;       /* how far to go if a test fails  */
  int   i;
  unsigned char  *sp;    /* current search point       */
  unsigned char  *ep;    /* last possible loc to try    */
  unsigned char  c;

  /* The use of unsigned chars is a necessity, since we are */
  /* going to use the char values as array indices       */

  /* set up the table of adjustments to the search point    */
  /* initialise for any char which isn't in search       */

  for (i = 0; i < 256; ++i)
    table[i] = searchlen;

  /* now reset table for chars in search pattern        */

  for (i = 0; i < searchlen -1; ++i)
    {
    c = (unsigned char) search[i];
    table[c] = searchlen - i - 1;
    }

  /* save value for last char and mark it as special      */

  c = (unsigned char) search[searchlen - 1];
  lastjmp = table[c];
  table[c] = 0;

  /* the actual search routine  */

  ep = (unsigned char *) text + textlen - searchlen;
  sp = (unsigned char *) text;

  while (sp < ep)
    {
    /* c = char which should match the last char search pattern */

    c = sp[searchlen -1];

    if (table[c] != 0)
      {
      /* not a match for last char, adjust the search  */
      /* point using the table and try again       */

      sp += table[c];
      continue;
      }

    /* This could be a match, at least the last char is right. */
    /* Actually compare strings at the search point.      */

    for (i = 0; i < searchlen; ++i)
      if (sp[i] != search[i])
        break;

    if (i == searchlen)
      return ((char *) sp);  /* found it!  */

    /* False alarm - it wasn't a match. Now we need the  */
    /* table value for the last char of the search pattern */
    /* which we saved for just this purpose...        */

    sp += lastjmp;

    }

  return (NULL);          /* buffer exhausted  */

  }
```

Figure 3 - Implementation of Boyer Moore.

Once this array is set up, we will be able to skip from 1 to *search length* characters for every character we actually examine in the buffer. For all but a few pathological cases, this will save an enormous number of iterations of the inner search loop. An example where it will not help much would be a search pattern of `'ab'` in a text buffer of all `'a'`s. It is also ill-suited to searches of very small text buffers, where the overhead of setting up the table is significant compared to the time for brute force searching.

The algorithm is guaranteed to terminate for all non-empty search patterns, since every entry in the table except the one for the last character of the search pattern will contain some positive value, as will the saved adjustment for the last character of the pattern. Therefore, every time we look in the buffer, we will either find the pattern or advance the search point, so sooner or later we will have examined the entire buffer.

Figure 3 is a straightforward implementation of the above. The code is far from optimised - it can be tightened up, but it will still be faster than the tightest assembler version of the brute force method.

Testing it out

The crude test harness shown in Figure 4 (run on a .DOC file of medium size, searching for a text string which occurs just once at offset about 31000 in the file) gave timings of 27.69 seconds for 100 brute force searches, 3.68 seconds for 100 Boyer Moore searches on a 16MHz 386SX.

Here are some statistics from this test -

Brute force - 31423 outer loops, 31557 inner loops. The inner string compare bombs out on the first character almost every time, but it executes often - there's little profit in making the compare faster, since it almost always terminates quickly. Any real savings to be made will be in setting up for the inner loop and testing for termination of the outer loop.

Boyer Moore - 3177 outer loops - we only ever looked at about one character in ten! 856 inner loops - of these 3177 looks, only 856 were occurrences which matched on the last character.

The search pattern used ends in a space - a very common character in a .DOC file. I deleted the space and repeated the test with the shorter string. The timings were virtually unchanged (down to 3.46 seconds from 3.68), but the statistics became

Brute force - 31423 outer loops, 31556 inner loops.

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Figure 4 - Test Harness to compare two search techniques.

```
#include  <stdio.h>
#include  <stdlib.h>
#include  <string.h>
#include  <bios.h>

static char buf[32000];
static char *search = "14H dispatcher ";   /* known to be in file */

void main (void)
  {
  FILE  *fp;
  int    i;
  long  start, stop, delta;

  /* an arbitrary choice of a text file to test on  */

  if ((fp = fopen ("d:/temp/mnpdrv/fossil.doc", "r")) == NULL)
    {
    perror ("Can't open test file");
    exit (1);
    }

  if (fread (buf, 32000, 1, fp) != 1)
    {
    perror ("Can't read test file");
    exit (1);
    }

  start = biostime (0, 0L);        /* Turbo C timer function */

  for (i = 0; i < 10; ++i)
    {
    if (brute_force (buf, 32000, search, strlen (search)) == NULL)
      {
      printf ("Brute force: not found\n");
      break;
      }
    }

  stop = biostime (0, 0L);
  delta = (stop - start) * 1000L;   /* 1000 * number of ticks    */
  delta /= 182;                     /* at 18.2 ticks/sec - gives  */
                                    /* seconds * 100             */
  printf ("Brute force: %ld.%02ld\n", delta / 100L, delta % 100L);

  start = biostime (0, 0L);

  for (i = 0; i < 10; ++i)
    {
    if (boyer_moore (buf, 32000, search, strlen (search)) == NULL)
      {
      printf ("Boyer Moore: not found\n");
      break;
      }
    }

  stop = biostime (0, 0L);
  delta = (stop - start) * 1000L;
  delta /= 182;

  printf ("Boyer Moore: %ld.%02ld\n", delta / 100L, delta % 100L);

  exit (0);

  }
```

Boyer Moore - 3222 outer loops, 158 inner loops - we've reduced the number of times we bothered with any further testing by a factor of 5. The fact that this did little in terms of performance suggests that possibly the bulk of the time is going in the outermost loop or the setup of the table itself.

The test code was compiled under Turbo C V2.0, small model. The test harnesss makes use of the Turbo library function `biostime();` but the rest of the code is in generic C. Last one to write a hot `grep` is a sissy!

EXE

JimSegrave is a freelance contract programmer specialising in system software. He can be reached as jes on CIX.

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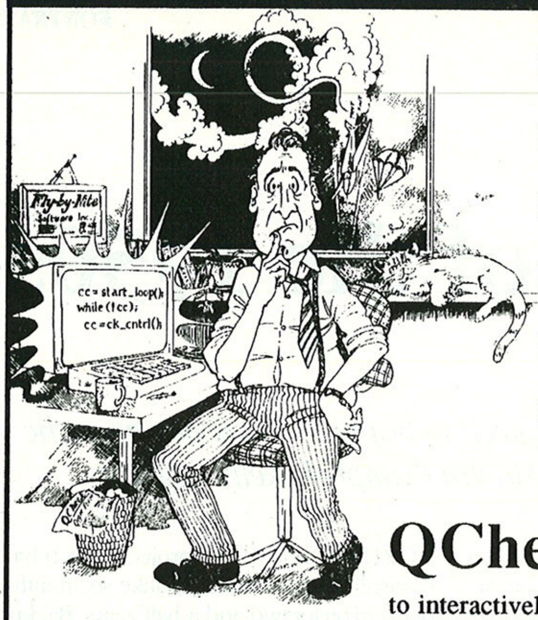

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CIRCLE NO. 177

FORTRAN: A Child of the 1950s

Some people think FORTRAN should never have been allowed to happen - yet it has been the greatest programming productivity lever of all time. Martin Campbell-Kelly explains.

FORTRAN gets a terrible press. Edsger Dijstra once said it 'is hopelessly inadequate for whatever computer application you have in mind today... too clumsy, too risky and too expensive'. FORTRAN has been blamed for the unstructured programming habits of a generation of programmers. And more spectacularly, FORTRAN was singled out as the underlying reason that the Mariner spacecraft - intended to be the first United States spacecraft to visit another planet (Venus) - had to be destroyed four minutes after lift-off on 22nd April 1962.

Yet the fact remains that for over 30 years, FORTRAN has been the most popular language for serious engineering and scientific applications. In number-crunching environments such as the aerospace industry, finite-element analysis, meteorological forecasting and high-energy physics, FORTRAN is almost universal. Often this is attributed to the triumph of IBM's marketing skill over its customers' judgement. But the real reason is encapsulated in the well-known epigram: *FORTRAN is a language to avoid - unless you want some answers.* The essential characteristics of FORTRAN are its efficiency, popularity and standardisation. It became popular because it was efficient; it became a standard because it was popular; and once it became a standard, FORTRAN was here for good.

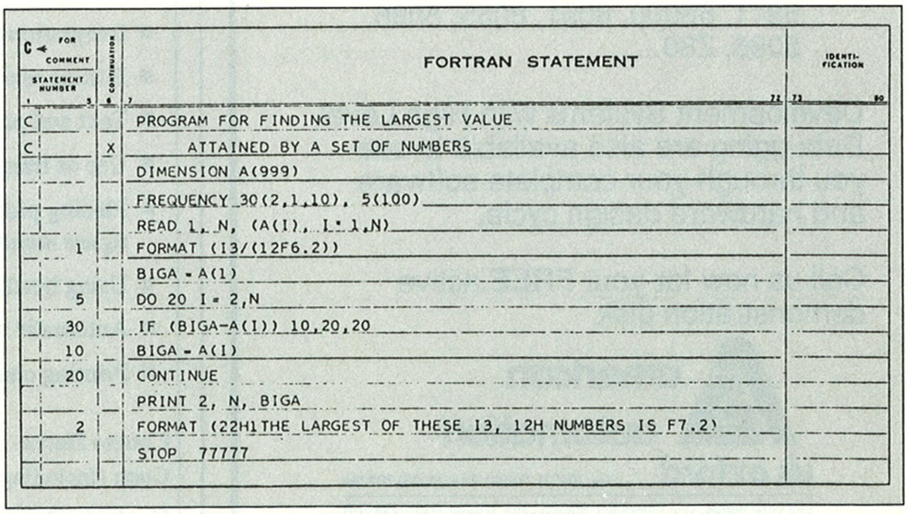
The origins

FORTRAN was invented in 1954. At that time, there were less than 100 computers world-wide, and the machine-code programmer was king. There had certainly been some attempts at 'automatic coding' - that is, getting a computer to do its own programming - but they had achieved very limited success. Compilations tended to be very slow (taking as much as half-an-hour on a $1 million machine) and the resulting programs were very inferior to those produced by a good machine-code programmer. The few automatic-coding systems that had been popular had mainly succeeded because their manifest inefficiency could be hidden behind the overhead of software floating-point routines. But the arrival of the IBM 704 computer with hardware floating point meant this would no longer be possible: there would be no place to hide object-code inefficiency. Whether it was possible to produce automatically machine code as good as that produced by a human programmer was a high-running controversy at the time; and a lot of mathematicians and engineers had staked their careers as machine-code programmers on the assumption it was not.

John Backus, an IBM high-flyer in his late twenties, had been the co-designer of the new model 704 with Gene Amdahl. In late 1953, he successfully proposed that he should organise a Programming Research Group to develop an automatic-coding system that would produce programs that were at least 90% as efficient as those written by a machine-code programmer. This was a major technical challenge, and not many people believed it could be done - including plenty of people in IBM. According to one of his contemporaries, there was a feeling that Backus had 'bitten off more than he could chew' and one IBM manager called it the 'FORTRAN fiasco'. The project, which had originally been intended to take six months, dragged on for two-and-a-half years. Backus himself was not immune to the criticism from the doubters and came close to giving up his leadership of the project; but he went on to complete one of the most remarkable pieces of programming in computer history. The compiler contained 18,000 machine instructions and took about 25 programmer-years of effort. The final cost was estimated by IBM at $475,000.

The language

FORTRAN was first defined in an historic document *Specifications for the IBM FORmula TRANslating System,* dated 10th November 1954. The primary goal of the FORTRAN project was object program efficiency, so that very little thought was given to the design of the language itself - as Backus later recalled, 'we simply made up the language as we went along'. One regrets this now, of course, but the idea of creating in FORTRAN a standard programming language for the future was quite inconceivable at the time. FORTRAN was designed for object program efficiency: designing an optimising compiler that would generate excellent



```
C ← FOR COMMENT | STATEMENT NUMBER | CONTINUATION | FORTRAN STATEMENT | IDENTIFICATION
C         PROGRAM FOR FINDING THE LARGEST VALUE
C        X     ATTAINED BY A SET OF NUMBERS
          DIMENSION A(999)
          FREQUENCY 30(2,1,10), 5(100)
          READ 1, N, (A(I), I = 1,N)
    1     FORMAT (I3/(12F6.2))
          BIGA = A(1)
    5     DO 20 I = 2,N
   30     IF (BIGA-A(I)) 10,20,20
   10     BIGA = A(I)
   20     CONTINUE
          PRINT 2, N, BIGA
    2     FORMAT (22H1THE LARGEST OF THESE I3, 12H NUMBERS IS F7.2)
          STOP  77777
```

Figure 1 - 'A complete but simple program'

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object code was the real challenge and the syntax of the language was very much a secondary issue.

Figure 1 shows an example program taken from the original FORTRAN manual produced by IBM and dated October 1956. Program statements were punched one to a card, with fixed fields for the statement number, the FORTRAN statement itself, and the card sequence number (in columns 73-80). This format has been carried down right to the present day, although virtually no-one punches programs on cards any longer.

Figure 2 shows the .EXE Triangle problem coded in the original FORTRAN for the IBM 704 computer. Perhaps the most remarkable feature of this program is that it needs just one correction to make it compile and run perfectly on a present-day FORTRAN system. (The correction is the deletion of the `FREQUENCY` statement - of which more later. My compiler also issued a 'warning' diagnostic because there was no `END` statement - a language refinement that did not, in fact, appear until FORTRAN II in 1958.) On the other hand, the program itself does not look very much like a 'modern' FORTRAN program; this is because it is written using the rather primitive statements available in the original 1957 FORTRAN; these statements still exist in the language for backwards compatibility, but some of them are now known as 'deprecated features' that are candidates for eventual removal from the language.

FORTRAN recognised two types of variable: fixed point (or index) and floating point. (In the 1966 FORTRAN standard, these became known as `INTEGER` and `REAL`.) Variables names could be a maximum of six characters in length. Why six? For the simple reason that the IBM 704 stored six 6-bit characters in its 36-bit word, and storing one identifier per word made table look-up easy and efficient. This is a restriction that has carried right down to the 1977 standard. Variables were not declared, but were implicitly typed according to the initial letter (`I` to `N` for fixed-point variables, and the remaining letters for floating-point variables). The implicit naming convention remains one of the most controversial features of FORTRAN, since simply misspelling an identifier can result in the creation of a 'phantom' variable. It was this particular feature that was (unfairly) blamed for the Mariner disaster, and became something of a *cause célèbre* for the use of programming languages with strongly-typed variables.

A major attraction of FORTRAN was its powerful arithmetic expressions, which accepted the five arithmetic operators and permitted parentheses nested to any depth. The important point, however, was that the translator could not only compile the expressions, but it would also produce virtually optimum code - for example, evaluating common sub-expressions only once.

Arrays were declared using the `DIMENSION` statement and could be one, two or three dimensional - a particularly advanced feature at the time. Closely allied to the use of arrays was the `DO` loop control statement. Looking very like the `FOR` statement of later languages, the control variable and its increment had to be of fixed-point type; this limitation was because, for efficiency reasons, the control variable was mapped onto an IBM 704 index register which stored only integer values.

The `IF` statement also reflected the underlying IBM 704 instruction set, which contained condition-branch instructions that tested whether a value was zero, positive or negative. Thus the statement IF (A+B) 10, 21, 15 would evaluate the expression A+B and: branch to 10 if the result was negative; branch to 21 if the result was zero; or go to 15 if it was positive. In the present age of goto-less programming, the arithmetic `IF` statement has largely fallen into disuse; and although it remains in the current FORTRAN standard for compatibility, it is considered a relic and its use is regarded as poor programming practice.

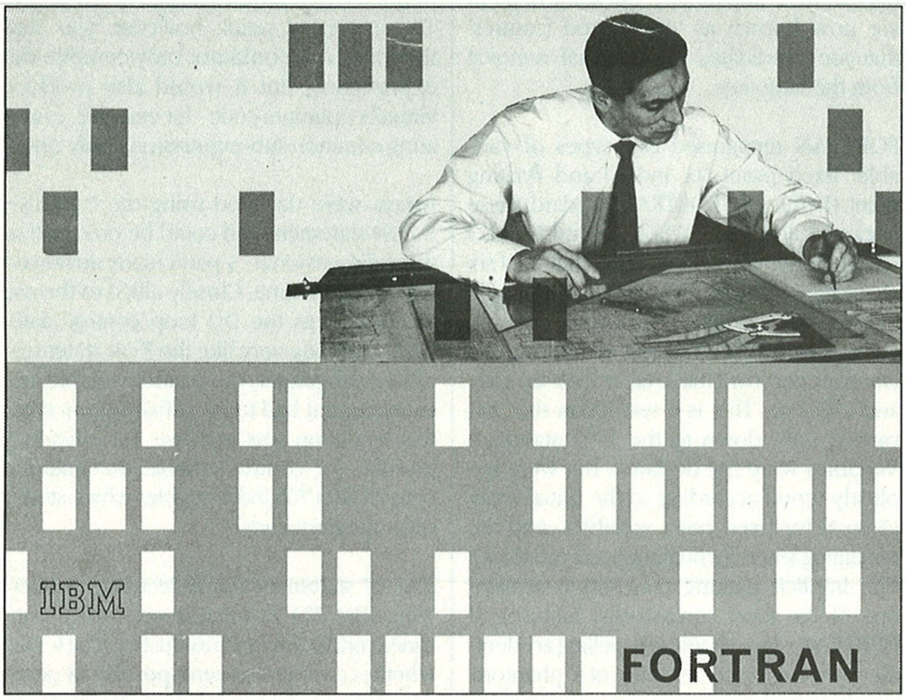
The input-output statements have much in common with the current standard, and are essentially a subset of it. One curiosity is the way of defining a string in a `FORMAT` statement, where a string such as `'TRIANGLE'` is written `8HTRIANGLE` (where 8 is the string length and H stands for the Hollerith punched-card code). The reason for this oddity is that the original IBM 026 card punch, used for preparing FORTRAN programs, did not have a quote mark in its character set. Again, this notation for defining string constants remains part of the FORTRAN standard for backwards compatibility.

The STOP statement is an interesting harkback to the days when FORTRAN programs were run in uni-programmed environments. The octal constant following the stop-statement (eg STOP 70707) would be displayed on the IBM 704 console display lights - this was useful for identifying error halts. A variant of the stop statement, PAUSE behaved similarly - but the program could be restarted by pressing the appropriate button on the console. This was useful for synchronising a program with its input-output (for example, halting the program to lead decks of data cards, or to change magnetic tapes),

```
C
C       THE TRIANGLE PROBLEM
C
        FREQUENCY 5(3)
        DIMENSION T(3)
        READ 100, T(1), T(2), T(3)
  100   FORMAT (3F6.2)
    5   DO 1 I = 1,3
    1   PRINT 101, T(I)
  101   FORMAT (3F6.2)
C
C       INEQUALITY TEST
        IF (T(1)-(T(2)+T(3))) 11,11,13
   11   IF (T(2)-(T(3)+T(1))) 12,12,13
   12   IF (T(3)-(T(1)+T(3))) 15,15,13
   13   PRINT 102
  102   FORMAT (22HTHIS IS NOT A TRIANGLE)
        GOTO 2
C
C       EQUILATERAL TEST
   15   IF (T(1) -T(2)) 20,16,20
   16   IF (T(1) -T(3)) 20,17,20
   17   PRINT 103
  103   FORMAT (31HTHIS IS AN EQUILATERAL TRIANGLE)
        GOTO 2
C
C       ISOSCELES TEST
   20   IF (T(1) -T(2)) 21,23,21
   21   IF (T(2) -T(3)) 22,23,22
   22   IF (T(3) -T(1)) 25,23,25
   23   PRINT 104
  104   FORMAT (29HTHIS IS AN ISOSCELES TRIANGLE)
        GOTO 2
C
C       TRIANGLE MUST BE SCALENE
   25   PRINT 105
  105   FORMAT (26HTHIS IS A SCALENE TRIANGLE)
    2   STOP 70707
```

Figure 2 - The Triangle Problem

Figure 3 - An IBM brochure for FORTRAN, circa 1960



and for tracing program errors. Again, the STOP and PAUSE statements are still part of the standard, and can be used meaningfully in conversational FORTRAN systems.

Finally, the FREQUENCY statement. The original purpose of this optional statement was to enable the programmer to give the compiler a hint that helped it to optimise the object program. For example, the statement FREQUENCY 10 (100), 21 (1, 2, 1) would mean: DO statement number 10 will be obeyed 100 times on average; and the three destinations of IF statement 21 will be taken in the approximate ratio 1:2:1. The compiler could make use of this information to fine-tune the object code. This was an important feature when FORTRAN was trying to gain credibility and efficiency was paramount; but later the FREQUENCY statement was ignored by most compilers and it did not appear in the 1966 standard.

The rise and rise of FORTRAN

FORTRAN was released in April 1957, to a largely sceptical user community. But when those same users discovered that FORTRAN could and did produce object programs 90% as good as hand-coded assembly language programs, the scepticism disappeared. Soon, many installations were spending half of the available machine time running FORTRAN programs and, by Autumn 1958, some 60 installations were using the system. The language proved to be an amazing productivity lever: a programmer could be trained in about 20 hours (compared to the weeks it took to get proficient at machine code); and, while programmers still tended to produce about the same number of debugged program statements per day, the fact that each FORTRAN statement was worth four or five machine-code statements meant that total output was increased by the same factor.

In IBM, scepticism towards FORTRAN now changed to positive support. It became a serious selling point and brochures and publicity material were produced (Figure 3). And as FORTRAN gained official product status, the project was transferred from the Programming Research Group to the Applied Programming Department, which took over field support and maintenance. Work also started in 1958 on a successor, FORTRAN II.

One of the major defects of the original FORTRAN had been that a user's program had to be completely recompiled every time it was corrected - and as a typical compilation took several minutes, this made program debugging very expensive. To improve on this, FORTRAN II introduced program units and subroutines (with corresponding END statements) and the concept of a linkage-editor. Now user programs and subroutines could be compiled just once and were subsequently linked together to produce a binary program. A consequence of this efficiency improvement was the development of large-scale, portable libraries of pre-compiled subroutines for matrix work and other numerical procedures, which further consolidated FORTRAN's popularity. The source-object-binary model of program organisation is today one of the universal characteristics of programming systems. It is not widely appreciated that its origins are in FORTRAN II.

In spite of the early success of FORTRAN, in the late 1950s its long-term future was far from assured. There was a major international effort to design and promote Algol 60 as a new world-wide standard for scientific programming; in fact, John Backus took a leading role in the Algol group and he had no commitment whatsoever to FORTRAN. However, during the period 1957-60 when Algol was being designed, US computer users took to FORTRAN so whole-heartedly that they began to demand that other manufacturers produce compilers compatible with IBM FORTRAN. Thus FORTRAN had already become a *de facto* standard by the time that the Algol 60 Report was published, so that in America the latter was never really a serious contender.

In the early 1960s, FORTRAN compilers from different manufacturers proliferated, but the lack of any sort of a FORTRAN standard meant that different implementations differed in small but important ways. It was to address this problem that the American Standards Association (ASA - later ANSI) established a FORTRAN committee in May 1962. The first FORTRAN standards appeared in 1966, which defined two versions of the language: Basic FORTRAN, roughly corresponding to IBM's FORTRAN II; and FORTRAN, corresponding to what was then IBM's latest offering, FORTRAN IV.

Standards committees grind exceedingly slow, and more than a decade was to pass before the next standard - FORTRAN 77 - was to emerge. The 1977 standard incorporated new control statements for structured programming which had come to the fore in the late 1960s and early 1970s; and there were features such as recursion, and support for non-numerical computation, time-shared operation, and direct-access devices. It says something for the adaptability of FORTRAN that it could take on-board all these new ideas and yet maintain almost total compatibility with the earlier FORTRANs.

The latest standard, FORTRAN 8X, of which few implementations yet exist, will take the language through the 1990s and into the next century. Years ago, Tony Hoare stated, 'I don't know what the language of the year 2000 will look like, but I know it will be called FORTRAN.' Well, FORTRAN 8X shows us what it looks like: it is a FORTRAN for today, but also one that is compatible with, and looks very much like, the FORTRANs that went before. The more FORTRAN changes; the more it stays the same.

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Dr Martin Campbell-Kelly lectures in computer history at Warwick University.

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CIRCLE NO. 164

No games until lunchtime

TIMELOCK is a utility by Robert Schifreen that allows you to restrict the days and times at which specific MS-DOS programs may be run.

Large computer systems come with clever utilities to prevent certain programs being run outside certain times of the day, or days of the week. It's possible to write such a program for the PC, and the TIMELOCK.ASM listing that you see here is my attempt to do just that. It's not foolproof, and anyone with a reasonable knowledge of MS-DOS will probably be able to get around it. However, if you look after a large department of computer-illiterate users, and you want to prevent them playing games except during the lunch hour or at weekends, then this utility is better than nothing. If you wish, you can also use it to place certain programs completely 'out of bounds'.

How It Works

Like most of the listings that find their way into the Code Page, TIMELOCK is a TSR. This time, we sit on Interrupt 21h, function 4Bh. This is the EXEC call which is used by MS-DOS to load and execute a program. Suppose a user runs a game program by typing INVADERS at the DOS prompt. COMMAND.COM then searches the current directory, and/or the path, for a file called INVADERS with an extension of .COM, .BAT or .EXE. Assuming that it finds the file, it calls DOS function 4Bh, with the full path name and filename of the file. For example, if you type INVADERS at the DOS prompt, the string that eventually gets passed to function 4Bh may be 'C:\ROBERT\GAMES\INVADERS.EXE'.

If all goes well, function 4Bh executes the file, and then returns with the carry flag clear. This

```
; TIMELOCK.ASM - v1.0, June 1990. Robert Schifreen.
; ------------------------------------------------

    code   segment
    assume  cs:code,ds:code,es:nothing
    org    0100h

start:

    jmp   init    ..      ; Installation code is at the end

intent:              ..   ; Come here on every Int 21h call

    pushf
    cmp   ah,04Bh         ; Is this an EXEC call?
    je   check_time       ; Jump to time-checker if it is
    jmp   intxeq          ; Else, do nothing

check_time:

                          ; An EXEC call is in progress. Get
                          ; name of file that's the subject
                          ; of EXEC call. Path name of file
                          ; is ASCIIZ, in DS:DX.

    push  ds
    push  bp
    push  di
    push  si
    push  ax
    push  bx
    push  cx
    push  dx

    mov   bp,dx

go_again:

    mov   ah,byte ptr ds:[bp]  ; Get char from ASCIIZ filename
    cmp   ah,0                 ; Are we at the end of the string?
    je   at_end                ; Jump if yes
    inc   bp                   ; Else increment pointer
    jmp   short go_again       ; And go get the next character

at_end:

                  ; BP now points to trailing zero. Work
                  ; backwards to find a backslash.

    mov   ah,byte ptr ds:[bp]  ; Get char
    cmp   ah,05Ch            ; Is it a backslash?
    je   backslash           ; Jump if found
    dec   bp                 ; Else, decrement counter...
    jmp   short at_end       ; ...And go round again

backslash:

                      ; DS:[BP] is the start of the ASCIIZ
                      ; filename, rather than a full pathname
                      ; with directory and drive info.
                      ; Search list of time limit records to
                      ; see if there's an entry for the file.

    mov   di,offset cs:limits  ; Start of time limit data
    inc   bp              ; Skip backslash and point to 1st char
    mov   si,bp           ; Keep a copy of BP

find_match:

    mov   ah,byte ptr ds:[bp]  ; Get char from filename to be EXECed
    mov   al,byte ptr cs:[di]  ; Get char from file in limits data
    cmp   ax,0            ; If both are zero, match was found
    je   match_found
    cmp   ah,al           ; Are both chars the same?
    jne   no_match        ; No, then strings don't match,
    inc   bp              ; Chars the same, so the strings...
    inc   di              ; ...Match so far. Keep checking.
    jmp   short find_match

no_match:

                      ; Current string does not match.

    mov bp,si         ; Reset BP to start of EXECing filename

                      ; Is there another file name in the
                      ; Time limit data records?
                      ; If so, see if it matches.

    inc   di

find_end:

    mov   al,byte ptr cs:[di]  ; Find the end of the current filename.
    cmp   al,0
    je   got_end
    inc   di
    jmp   short find_end

got_end:

                        ; DI points to the trailing zero of a
                        ; Limits filename. Skip the time data
                        ; And see if there's another filename.

    add   di,49         ; Skip 48 bytes of time data
    cmp   byte ptr cs:[di],0   ; Are we on an end_of_records marker
    je   no_more
    jmp   find_mat      ; Go look for another match

no_more:

                        ; The string does not exist in the
                        ; List of prohibited files, so
                        ; Execute it as normal.
```

Figure 1 - TIMELOCK.ASM

tells the caller that the program was successfully executed. If for some reason the program cannot be executed, function 4Bh returns with the carry flag set, and an error code in AX. One such error code is Access Denied, which is error code 5. This is returned if, for example, a file cannot be loaded because it is already in use somewhere else on a network. COMMAND.COM then displays the error message.

TIMELOCK is very simple. It maintains a list of files that may not be run and, if you attempt to run one of these, at a forbidden time of day, it returns an error code 5 to the routine that called function 4Bh, instead of loading and executing the file. This means that the user will see an error message Access Denied if he tries to run a program at a forbidden time.

Of course, there's an easy way around this. The user could simply rename the file, to a name that doesn't appear in the forbidden list. The user could also boot from a floppy disk, to avoid the TIMELOCK program being run at all, or change the system time and date. The first situation is easy to get around - use something like DDC to prohibit use of the RENAME command. (DDC is a utility to disable the use of internal DOS commands, and appeared in a recent Code Page article). You could, if you wish, write a special TSR that refuses to let the user rename files whose names are the subject of a TIMELOCK forbidden list.

As it stands, TIMELOCK is deliberately unfriendly. It doesn't print a message when it loads, so the user will not easily be able to tell that it is in force. Also, I haven't included any easy way of amending the list of files, or the times at which the files can be run. To configure these, you have to edit the source code and reassemble. This again is a deliberate piece of hostility.

The format of the data area is quite straightforward. Each data record starts with a zero-terminated filename. This is the name of the file whose use you wish to restrict. Following the name of the file are 48 data bytes. The first 24 of these govern the use of the file during weekends, ie when the system day-of-the-week call returns Saturday or Sunday. The remaining 24 bytes govern the use of the file on weekdays. Each of the 24 bytes relates to one specific hour as follows: if byte n is set to 1, then use of the file is permitted when the current hour is n. If the byte is zero, then use of the file is not permitted.

So, to forbid the use of a file between 1pm and 2pm, you need to set the 14th byte (byte 13) to 0. This locks the file between 13:00 and 13:59, which is near enough. You can have as many records as you like, as long as the size of the .COM file doesn't exceed 64 KB. Just remember to add the terminating zero after the last record.

Incidentally, I could easily have bit-mapped the data area. To hold data for 24 hours takes only 24 bits, which fit snugly into 3 bytes. However, unless you have a large number of forbidden files, the extra code required to manipulate the bitmaps means that you don't save much memory at all. And the coding would have been harder, too.

EXE

```
    pop   dx
    pop   cx
    pop   bx
    pop   ax
    pop   si
    pop   di
    pop   bp
    pop   ds

    jmp   intxeq

match_found:

    inc   di

                        ; The file that DOS wants to EXEC is
                        ; The subject of a timelock.
                        ; CS:[DI] is the first byte of the
                        ; file's 48 timelock data bytes.
                        ; The first 24 bytes are for Sat & Sun.
                        ; The next 24 are Mon-Fri.

    mov   ah,2Ah
    int   21h              ; Get day of week into AL
    cmp   al,0             ; Is today Sunday?
    je    weekend          ; Jump if so.
    cmp   al,6             ; Is today Saturday?
    je    weekend          ; Jump if so
    add   di,24            ; Today is not weekend, so skip the
                           ; weekend data bytes.

weekend:

                        ; CS:[DI] now points to the start of
                        ; 24 bytes that govern today's rules
                        ; for the execution of the file.

    mov   ah,2Ch           ; Get the current hour
    int   21h              ; Get hour (0 - 23) in CH.
    mov   cl,ch            ; Put hours into CL
    mov   ch,0             ; Zero CH, to make CX = hours
    add   di,cx            ; Point to correct data byte for
                           ; Current hour.

    cmp   byte ptr cs:[di],1    ; Is execution permitted?
    je    permitted

                        ; Execution forbidden. Set carry flag
                        ; to tell DOS that file can't be
                        ; executed.

    pop   dx
    pop   cx
    pop   bx
    pop   ax
    pop   si
    pop   di
    pop   bp
    pop   ds

    popf
    mov   ax,5             ; Return "Access Denied" error to DOS.
    stc                    ; Set carry flag to indicate error

    retf  2                ; And we're all done. IRET instead of
                           ; Chaining to Int 21h func 4Bh handler.
                           ; Use RETF 2 instead of IRET, to avoid
                           ; corrupting flags register.
permitted:

    pop   dx
    pop   cx
    pop   bx
    pop   ax
    pop   si
    pop   di
    pop   bp
    pop   ds

intxeq:

    popf                   ; Retrieve flags from stack.
    db    0EAH             ; Absolute JMP (segment + offset)
intip  dw   0              ; Filled by init code
intcs  dw   0              ; Filled by init code

                           ; Start of data for list of files.


limits db 'DEBUG.EXE',0               ; Filename
    db 1,0,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1 ; Sat & Sun
    db 1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1 ; Mon-Fri

    db 'DEBUG.COM',0                  ; Filename
    db 1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1 ; Sat & Sun
    db 1,1,1,0,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1 ; Mon-Fri

    db 0                              ; No more data


                                      ; Install TimeLock program.

init:

    push  ax
    push  es
    mov   es,cs:[2ch]      ; get seg adr of our env block
    mov   ah,49h           ; free a block
    int   21h              ; free the block
    pop   es
    pop   ax

    mov   ax,cs            ; Set DS = CS
    mov   ds,ax
    mov   ah,35h           ; Get old interrupt vector
    mov   al,21h
    int   21h
    mov   intcs,es         ; Save in long JMP
    mov   intip,bx
    mov   ah,25h           ; Set new interrupt vector
    mov   al,21h
    mov   dx,offset intent
    int   21h
    mov   ax,3100h         ; Termination function
    mov   dx,(init-start)/16+17
    int   21h              ; Terminate and stay resident.

    code  ends
    end   start            ; End of TIMELOCK.ASM
```

Figure 1 - TIMELOCK.ASM (Continued)

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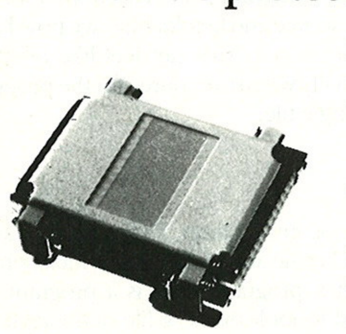

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CIRCLE NO. 167

Xtx

Our UNIX sage, Peter Collinson, is a self confessed ten-thumbed typist with amnesia. However, he has devised ways to overcome his handicaps.

I have always been a dreadful typist. It's not that I don't know where the keys are, or that I look at the keyboard all the time - but somehow I always seem to be hitting the wrong key. Usually it's the one next to the one I want, or a sequence close to the one I had in mind. Luckily the Delete key on my keyboard is a big one.

The disability makes it difficult to type commands into the shell accurately and I do sometimes find myself typing some mis-spelt command again and again. I have resisted the temptation to alias `vay` to `cat` (Figure 1), but have succumbed to a permanent alias of `dc` to `cd` – largely because `dc` is such a pain to get out of when typed accidentally. As a result of all this, I have always invested time into systems which will help me to avoid typing.

Make

One of these systems is `make`. Simply typing

```
make
```

is always much better than attempting the complicated `cc` instruction needed to compile that program.

I tend to insert various targets into my `makefile`'s, like:

```
clean:
    -rm -f $(OBJS) $(TARGET)
    -rm -f core errs
```

The hyphens before the `rm` commands mean 'continue even if these commands fail', otherwise `make` will stop when `rm` fails to find any file to delete. The `$(OBJS)` string is replaced by a list of object files and similarly the `$(TARGET)` string is the main executable being created by the `make`. Both of these are assumed to be declared earlier in the `makefile`. I can now always type:

```
make clean
```

at the shell to ensure that the directory is stripped down to its essential source files.

The ability to have different 'dummy' targets like `clean` means that `make` is a useful way of storing recipes for processing general data. It should not be thought of as solely a programming tool. For example, if you use `troff` for document processing, then a `makefile` can easily be used to contain all that pipeline stuff needed to sequence the various utilities to process the data. Consider this `makefile`:

```
draft:
  tbl dc.mm | nroff -mm | col
top:
  tbl dc.mm | psroff -mm | \
    lpr -PPostScript
```

This makes no clever use of make but means that you simply need to type

```
make
```

to see the draft output, and

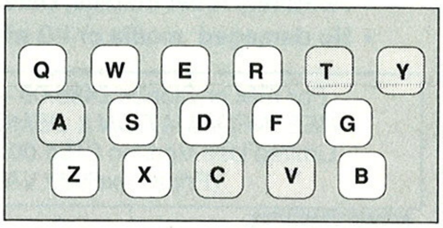
```
make top
```

can be used to deliver the final copy to the printer.

Brain can't take the strain?

`Make` also helps me with another failing: loss of memory. Once a program is written and out of the way, I can never remember it. I immediately forget how it works, what was nice or nasty about it. Memory sometimes comes flooding back when I see the source, but I often have to work out why I inserted those stupid bugs in the first place.

Figure 1
Typing 'vay' instead of 'cat'.



`Make` removes some of the uncertainty. The existence of a `makefile` with its rules for creating the program means that I can return several years later without having to remember what commands were used to create the binary and what particular libraries were included.

However, the bag and baggage associated with the program is increased. In addition to the source and header files, we now have a `makefile`. This can feel like overkill, especially when the source for the program is a single file.

Xtx

Some of my feelings about this surfaced when I came across the simple idea behind the `xtx` program. `Xtx` is a program designed to look inside a file and execute a command that it finds embedded there. The file is not a shell script but source data for another command - perhaps the file contains C source and I want to run the compiler on it to generate an executable program. Mostly these days I use the command in `troff` source files, a comment line in the document will contain something like:

```
<-xtx-*> psroff -ms -t %
```

The string starting with '<' and ending with '>' is a marker that will hopefully never naturally occur in any text file. When I say

```
xtx file.ms
```

`xtx` looks for the marker string, eats any optional white space after the trailing '>', and takes the remainder of the line to be a command passed to the shell for execution.

```
#!/bin/sh
# simple xtx shell script
#
case $# in
1)
  filename=$1
  ;;
*)
  echo 'Usage: xtx filename'
  exit 1
esac
# look for <-xtx-.> using grep
# the dot matches any character
#
# the use sed to remove the marker
# and change % into filename
# The use of '...'"..."
# is intentional
# Type the quote characters carefully
command=`grep '<-xtx-.>' $filename |
  sed -e 's/^.*<-xtx-.> //'"
  s/%/$filename/"`
eval $command
```

Figure 2 - Simple xtx shell script.

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CIRCLE NO. 168

The '%' character provides a convenient way of saying 'here's the place to add the current filename into the command'.

A plausible shell version of the command is to be found in Figure 2 and the full C version in Figure 3.

The C program

The C program expands on the basic idea a little. It's nice to be able to store more than one command in the file and select the one to be used from the command line. This is done by replacing the star in the marker string by another letter and then selecting that letter from the command line. For example, you can run `lint` on the C program by typing

```
xtx -c l xtx.c
```

A few caveats about the C program. As you can see it was written in 1985 and I have resisted the temptation to tart it up for inclusion in .EXE in 1990. So, it's not in ANSI C - and doesn't use `getopt()` to decode arguments. I reason that a tested working program is worth more than one which is messed up for religious or cosmetic reasons. If you're a C programmer - then sorry about the bracketing style. Actually, I'm not that apologetic - I like to have opening '{' and closing '}' lined up in the text. Old habits die hard.

(*Continued on page 70*)

```
/***

* program name:
  xtx.c
* function:
  Looks in a file for a string of the form
    <-xtx-[letter]>
  If the string is followed by a line ending with a \n
  Then takes the line and executes it using /bin/sh
  The letter is used to select one of a number of commands
  which may be embedded in the file. The character '*' is
  used to mean the default.
* switches:
  -c [letter] select a particular line in the file
  -e   echo the matched command from the file
  -a   print all matched commands from the file and their
      key letter
  files
  -    Take data from standard input for scanning
* compile time parameters:
<-xtx-*>  cc -o xtx -O xtx.c
<-xtx-l>  lint -h xtx.c
* history:
  Written October 1985 Peter Collinson
***/
#include <stdio.h>
#include <ctype.h>

char  cmdbuf[BUFSIZ];   /* Where to store the command */
char  expanded[BUFSIZ];  /* expanded version - includes filename */

char  selchar='*';     /* selection character */
int echosw;           /* set if echo only */
int allsw;           /* print all matched commands from the file */

#define WILD  1        /* Wild character in the string below */
char  matchs[] =       /* Used to find a match with a command */
{  '<','-','x','t','x','-',WILD,'>'  };
#define STORESTATE (sizeof matchs)

char Usage[] = "Usage:xtx [-e][-a][-c letter] files..\n";

main(argc, argv)
char **argv;
{
  register char *p;
  FILE *fd;

  while (--argc)
  {  p = *++argv;
    switch (*p)
    {
    case '-':
      p++;
      switch (*p)
      {
      case 'a':
        allsw++;
        echosw++;
        break;
      case 'c':
        if (--argc)
        {  argv++;
          selchar = **argv;
        }
        else
          fatal("No argument to -c given\n");
        break;
      case 'e':
        echosw++;
        break;
      case '\0':
        scanfile(stdin);
        if (cmdbuf[0])
          execute(0, cmdbuf);
        break;
      default:
        fatal(Usage);
      }
      break;
    default:
      if ((fd = fopen(argv[0], "r")) == NULL)
      {  perror(argv[0]);
        break;
      }
      scanfile(argv[0], fd);
      (void) fclose(fd);
      if (cmdbuf[0])
        execute(argv[0], cmdbuf);
      break;
    }
  }
  exit(1);  /* Command has failed */
}

/*
 * Scan a file looking for an appropriate line
 */
scanfile(fname, fd)
register char *fname;
FILE *fd;
{
  register c;
  register state = 0;
  register char *cmdp;

  while ((c = getc(fd)) != EOF)
  {  if (state == STORESTATE)
    {  if (isprint(c) || isspace(c))
      {  if (c == '\n')
        {  *cmdp = '\0';
          if (allsw)
          {  execute(fname, cmdbuf);
            state = 0;
            continue;
          }
          return;
        }
        else
        if (cmdp < &cmdbuf[BUFSIZ])
          *cmdp++ = c;
        continue;
      }
      state = 0;
    }
    else
    if (matchs[state] == WILD)
    {  if (allsw)
        selchar = c;
      if (c == selchar)
        state++;
      else  state = 0;
    }
    else
    if (c == matchs[state])
    {  if (state++ == 0)
      {  cmdp = cmdbuf; *cmdp = '\0';  }
    }
    else  state = 0;
  }
}

/*
 * Call the shell
 */
execute(fname, cmdp)
register char *fname;
register char *cmdp;
{
  register char *p;
  register char *f;

  for (; isspace(*cmdp); cmdp++);

  if (fname)
    for (p = expanded; *cmdp; cmdp++)
    {  if (*cmdp == '%')
        for (f = fname; *f; *p++ = *f++);
      else
        *p++ = *cmdp;
    }
  *p = '\0';

  if (allsw)
    fprintf(stderr, "%c\t%s\n", selchar, expanded);
  else
    fprintf(stderr, "%s\n", expanded);
  if (allsw)
    return;
  if (echosw)
    exit(0);
  execl("/bin/sh", "sh", "-c", expanded, 0);
  perror("Exec");
  exit(1);
}

fatal(str)
char *str;
{
  fprintf(stderr, str);
  exit(1);
}
```

Figure 3 - The xtx program.

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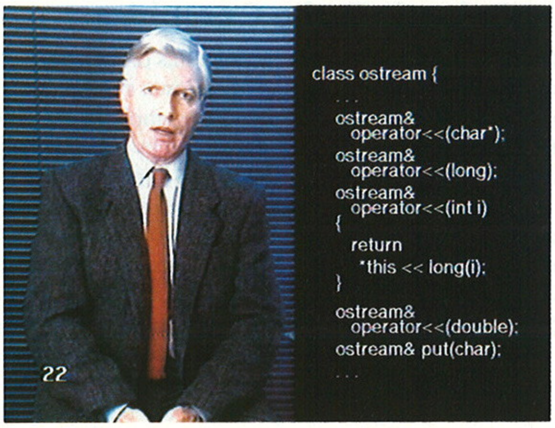

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Books

The EISA standard for PC architecture is celebrated in a book of its own; and a stylish introduction to Turbo C's graphics.

EISA not neisa

EISA. Yes you do, the Gang of Nine, two fingers waved at IBM, brave new alternative to MCA bus. All that. Now that we are beginning to see some EISA-class machines in the windows of the dealers, what a good opportunity for somebody to bring out a nice little pamphlet, for the benefit of the lay programmer/user who does not intend to run up a network card, this week.

Inside the EISA Computers is a little pamphlet wrapped up in a rather larger book. I challenge the author, Tony Dowden, to put his hand on his heart and tell me that the chapter on MS-DOS V4.0 commands (yes, DIR and that crew) serves any purpose other than to dirty a few blank pages with ink. Similarly, we have a chapter of serial port documentation which contains diagrams of the pin arrangement of both 25 pin *and* 9 pin D-type connectors, suggests how to wire null modem cables, initiates us in the mysteries of serially transmitted data, even throws in a couple of assembly language routines that use INT 14H. Chapters on The Operating System, VGA, the Parallel Printer and 80486 similarly take the Michael.

So what is one left with, once the explanations of Binary Numbering Systems and BIOS calls have been hacked away? Well, there is a diagram of the rather clever way that the EISA connector is designed, so that EISA cards and ISA cards use completely different sets of contacts, although they both fit into the same hole. There is a list of all the signals on the bus, a brief description of the DMA system and an I/O memory map. EISA includes a neat configuration facility, so that a board manufacturer can include data about his cards in the machine's SETUP facility. There is a big chapter about this, with loads of interesting-looking C code; but I can't see it being of any use to anyone except a board manufacturer.

The first book about something new is often disappointing. This is, and it is (if you see what I mean). Let's hang on; there will be another along in a minute.

Inside the EISA Computers — *Author: Tony Dowden*
Publisher: Addison Wesley — *Price: £19.75*
ISBN: 0-201-52397-3 — *Pages: 236*

Quixotic Turbo C graphics

A lot of books come through this office - perk of the job and all that - and I have developed my own system of classification. The volume in question is a good example of the *John Wiley Mildly Eccentric* - the genre characterised by a slightly off-beat approach to a well-trodden topic. *Graphics Programming in Turbo C* is yet another tutorial intended for the beginner - probably one who has only just sorted out his `floats` from his `doubles`. However, if this happens to be your current position, I think that this would be a good choice of text to help you cut your graphical teeth.

The approach is closely tied to Borland's BGI graphics library, so you really will need a copy of Turbo C V2.0 or better. The book is packed with lots of little examples which grow in complexity towards the back. Many of these are beautifully original - at least in my experience. The arc and circle functions, for example, are used to create an exquisite net pattern (as well as the traditional rectangle with rounded corners). The fill routines are pressed into service (in about a page of code) to produce the elegant rendition of Escher's 'impossible' triangle which adorns the cover of the book. The illustrations, incidentally, are all simple monochrome screen dumps; but they have a uniformity of style which makes them more pleasing to look at than many a flash colour plate.

It's not just pretty. A chapter on mouse input is most welcome (since there's no direct support for this in Turbo's library; one is obliged to mess about at interrupt level), as is some practical code for doing menus and pop-ups. I also liked the program which produced HP-GL output, written to a file. The idea is that you can import your Turbo C graphics into WordPerfect V5.0, and so become a desk-top publisher.

Less originally, the *pièce de résistance* is a cut-down CAD application, which is 16 pages of C long. Never mind. A tear out flyer stuck in the front offers the accompanying disk set at £12.65 - which is nearly as much as the book itself.

Graphics Programming in Turbo C — *Author: Leendert Ammeraal*
Publisher: John Wiley — *Price: £12.95*
ISBN: 0-471-92439-3 — *Pages: 199*

UNIX Regular *(Continued from page 68)*

The C program does have some interesting coding aspects. The work gets done in the `scanfile()` routine, and this is coded in an attempt to make it scan data as fast as possible. I avoid examining the data twice by NOT calling `fgets()` or gets`()` to get a line of data and then scanning that data for the magic string.

It's much faster to use `getc` to get a character, then have a finite state machine to recognise the string that we are looking for. The main loop of `scanfile()` is a call to `getc` and a set of tests. `getc` is implemented as a macro, generally accessing the read buffer directly and so is fast. The `state` variable is used to select the exact comparison to be made for the particular character that has just been read. If a successful test is made, the state is moved to the next one; and the next character in the `matchs[]` vector is sought in the input. The remainder of the input line is stored if a successful complete match is found.

Acknowledgements

This idea was originated by Tom Duff from AT&T Bell Laboratories. His command is called `com`, because it is for COMpiling files. I had the idea from David Tibrook.

In the absence of source, I took the idea and created `xtx` named because you are eXecuting from TeXt. The command is pronounced 'ex-tex'. Enjoy.

EXE

Peter Collinson is a freelance consultant specialising in UNIX. He can be reached electronically as `pc@hillside.co.uk` *(although your mailer might be happier to put the address the other way round) or by phone on 0227 761824.*

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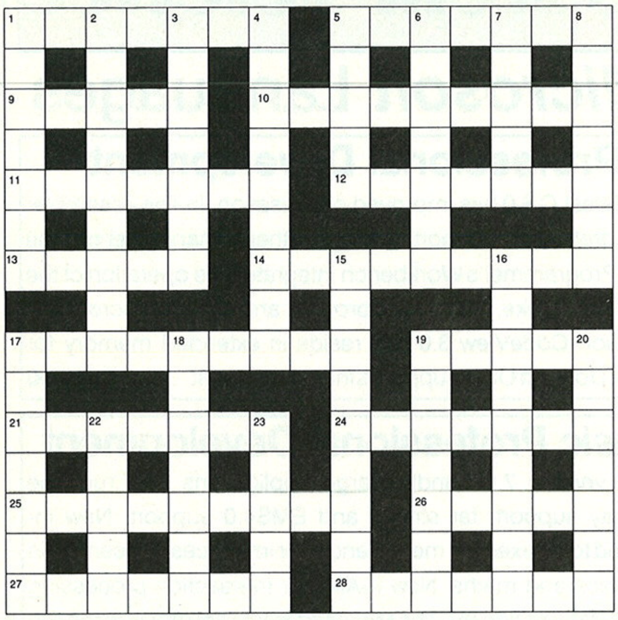

ACROSS

1 Micro output collection may translate (7)
5 A sugary system (7)
9 Earful on the line (5)
10 Surgical system? (9)
11 Fighting medievally, headlessly pushing out (7)
12 Three-toothed missile (7)
13 Wear away as Elizabeth went by horse (5)
14 Best left to experts with technique? (9)
17 Before screen flasher that gives warning (9)
19 Pentavalent impurity with blood to spare? (5)
21 Summary to be coded later (7)
24 Brings in current data (7)
25 Get rid of broken line I tame (9)
26 Lager ones best avoided (5)
27 Wandered off with food carrier in backward ministry (7)
28 Spanish festivals for screen animations (7)

DOWN

1 Cheer up the operator's desk (7)
2 It gives immediate access to data (4,5)
3 Tick off and list chunks of data (7)
4 Increases size of almost lone logic elements (9)
5 Creative person's job finder (5)
6 Where you get to travel on a network (7)
7 Aries may somehow lift up (5)
8 Two-fingered in our cases (7)
15 Cyclic displays of screen pages (9)
16 Build an algorithmic base (9)
17 Business between input and output (7)
18 Useful little routine (7)
19 Cheat on the roof with a fresh start (7)
20 How chips' coating opposes current (7)
22 Three way start then hesitation for game one (5)
23 Antelope from oriental country (5)

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L	I	A	I	S	E	S		D	I	S	B	A	R	S
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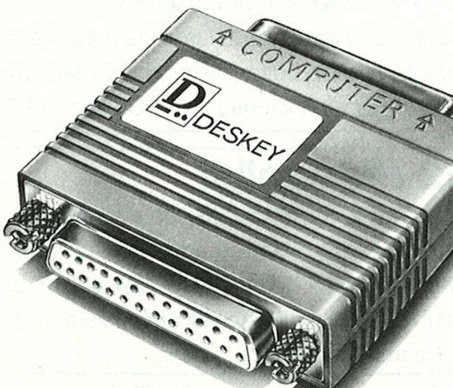

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CIRCLE NO. 174

GERMANY BECOMES THE TARGET AS EUROPE BOOMS

Recruitment experts are keeping their eyes on the economic and political changes in Germany in the hope that unification will open up the contractors market.

Many agencies have traditionally relied on the Benelux countries and France to hire UK staff, while Germany has been regarded as a relatively closed market. Observers think, however, that the barriers will soon come down.

Peter Jobson, regional manager at Datapool Consultants, said that a large market was likely to emerge as restrictions are eased. He maintains that foreign contractors have had difficulties in the past because trade union agreements were favourable to local staff, and he cites a recent case where UK contractors were physically ejected from a firm by union members.

Paul Smith at Real-Time Consultants also complained that German legislation is 'far too restrictive' at the moment, but said one of the next tasks for the company is to look at operating there.

Most agencies operating in Europe are optimistic about the current state of the market, which has not suffered from the downturn seen in the UK this year. Datapool's Peter Jobson said: 'The market is very good indeed. The rates are very reasonable, taking into account the cost of living in other countries. It's all very attractive for the British.'

David Mitchell, overseas director at Hunterskil, added: 'In the UK, firms are backing off doing major projects if they can. But it's pretty much the status quo over there. If anything they're probably more geared to 1992, and perhaps they're developing more than usual, particularly centralised operations like government bodies.'

Traditionally, the most popular countries for UK freelances have also been the nearest, and contracting in the Benelux states has been possible almost as long as it has in the UK.

The tax and national insurance regulations are complex and vary hugely from country to country, however. According to agencies, they are notoriously stringent in the Netherlands.

Hunterskil's Mitchell said his firm has been involved in negotiations with Dutch tax authorities to establish a system which would allow UK contractors to operate there through the agency. The firm has had to set up what amounts to a PAYE scheme for its contractors, where tax is deducted at source with a limited amount of earnings held back to cover expenses.

Paul Smith at Real-Time Consultants, however, thinks the severe tax regime in the Netherlands could put some contractors off: 'I think freelances prefer to operate through their own limited companies and make their own arrangements - part of that includes the flexibility to manage their own financial affairs.'

Real-Time Consultants also deals mainly with Benelux states and France. According to Smith, France in particular has been opening up over the last year, with more opportunities in larger companies.

Keith Rodgers

EXE

DOWNTURN LEAVES CONTRACTORS TWIDDLING THEIR THUMBS

Large numbers of contractors are expected to be out of a job during the rest of this year as the market feels the squeeze and temporary work tails off.

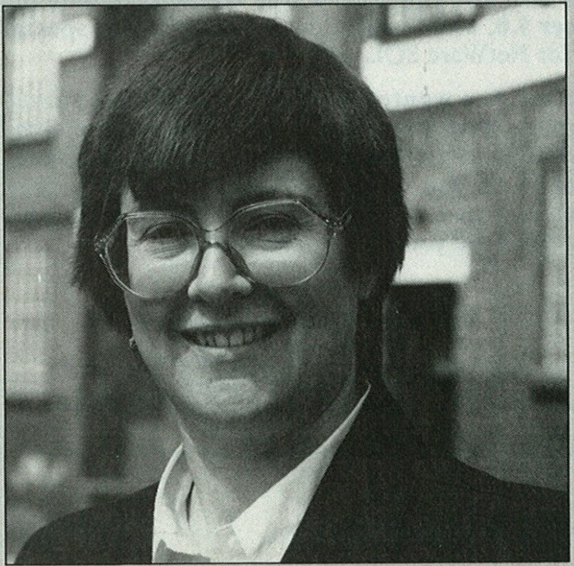
According to the Computer Freelancers Association, even members working in the traditionally strong PC sector are feeling the pinch, as unemployed contractors from other fields move around to find work. The picture is not expected to improve before the end of the year.

Douglas Milnes at the Association said, 'There are a lot of contractors sitting at home and twiddling their thumbs'; including senior systems analysts as well as junior programmers.

The root of the problem is the unsettled economic climate, which has hit the confidence of the market. On top of that, jobs in the City, one of the largest employers of freelances, have been cut. While the Association expects that part of the market to settle, it is unlikely to do so this year.

Milnes also pointed out that a fall in hardware sales last year, which led to a drop in software requirements, was now being felt by contractors. Hardware sales are picking up again, but it could be another twelve months before levels of work follow suit.

Janet Knott, manager of the contracts division at BIS, described the market as 'patchy', and added: 'What we're finding is that people are putting off taking on contractors, but when they want them, they want them yesterday. It's very much a case that, unless people are immediately available, they won't be considered for interview.'



Knott: 'Contractors market patchy'.

Referring to the PC market, she said: 'We're still suffering from the fact that years ago a lot of people set up as consultants working from home. We're finding that, for the last year or so, those people need help when they can't find work, so if anything there's an oversupply in the market.'

For all that, Milnes expects contractors' rates to stay fairly steady because a lot of professionals, used to earning high salaries, won't want to discount. As the market is squeezed, however, they are likely to be more willing to travel further.

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```
INCLUDE OPPORTUNITIES.h /* THE BEST AROUND */
INCLUDE EXPERIENCE.h /* 2 YRS+ REQUIRFED */
DEFINE ENVIRONMENT "Development"
DEFINE PACKAGE "Excellent"
main ()

printf ("call now or send cv for immediate interview/n")
printf ("we meet all relevant candidates/n evenings also/n")
```

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CIRCLE NO. 178

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STOB - That divine spark

Verity answers your questions about artificial intelligence.

What is the goal of AI?

It is, of course, a vast simplification to think of the whole of the AI movement moving towards a single goal. There are in fact three. These are:

1) To produce a program that plays noughts and crosses infallibly.

2) To produce a program that plays chess infallibly.

3) To produce a working replica of Robbie the Robot, as seen in the 1950s sci-fi film 'Forbidden Planet'.

How far has it moved toward these goals?

The noughts and crosses one they have more or less cracked. Chess is proving a tougher nut. It was easy to reproduce the skill level of the average human player (gets the position of the rooks and the bishops the wrong way round, refers to the small doorknob-shaped pieces as 'prawns') or even the talented amateur (pretends to understand castling), but to achieve a true Grand Master level (genuinely interested in chess puzzles printed in Sunday Papers) is many years away yet.

Sad to say, the chances of duplicating Robbie the Robot are receding as time passes - the art of fashioning Perspex with such skill having been lost in the early 1960s.

What is the best example of a successful AI application?

The only successful example of an AI application was the ELIZA program (Weizenbaum, 1907). This was able to hold a dialogue with the operator in natural English.

Was that the silly program that pretended to be a psychologist?

Yes, it relied upon a system of identifying key phrases. The main disadvantage was that, whenever asked a difficult question, it tended to change the subject.

Wasn't ELIZA a bit of a cheat, then?

Why don't you ask me about AI languages?

Oh, all right. What about the AI languages?

There are three AI languages: LISP, Prolog and POP. They can be distinguished thus: LISP is the one with loads of brackets, Prolog(ue) is the European language with a US spelling and POP is the Great British Hope.

And what are the best-known AI applications of these languages?

The best-known AI application of LISP is CAD, such as AutoCad. The best-known application of Prolog is to buy a copy of Turbo Prolog in a rash moment, and leave it on the shelf collecting dust, always meaning to take it down and have a go. The best known application of POP is to be the subject of magazine articles entitled: 'POP - the British AI language.'

No, I meant what* programs *are written using them?

Only one program has ever been written using these languages: the 'Towers of Hanoi' game.

Surely the problem with AI languages is that they are too slow for commercial work?

There are certainly no flies on you. In 1988, a Respected Industry Commentator said that, in the next three years, hardware will speed up sufficiently to fix this.

So AI will be viable in 1991?

No, in 1993. AI will always become feasible in three years' time. This is an application of Carrollian logic programming - 'Jam tomorrow'. Remember, 95% of AI text books contain a quote from *Through the Looking Glass.*

Is there anything else I should know about AI?

An inference engine is a two-stroke version of a database engine. A knowledge engineer earns tons more money than you do. Backward chaining is still illegal in certain States of the US. Waltz's Algorithm is much less fun than its name.

Verity, thanks very much for your valuable time.

Always a pleasure for you, sweetie.

EXE

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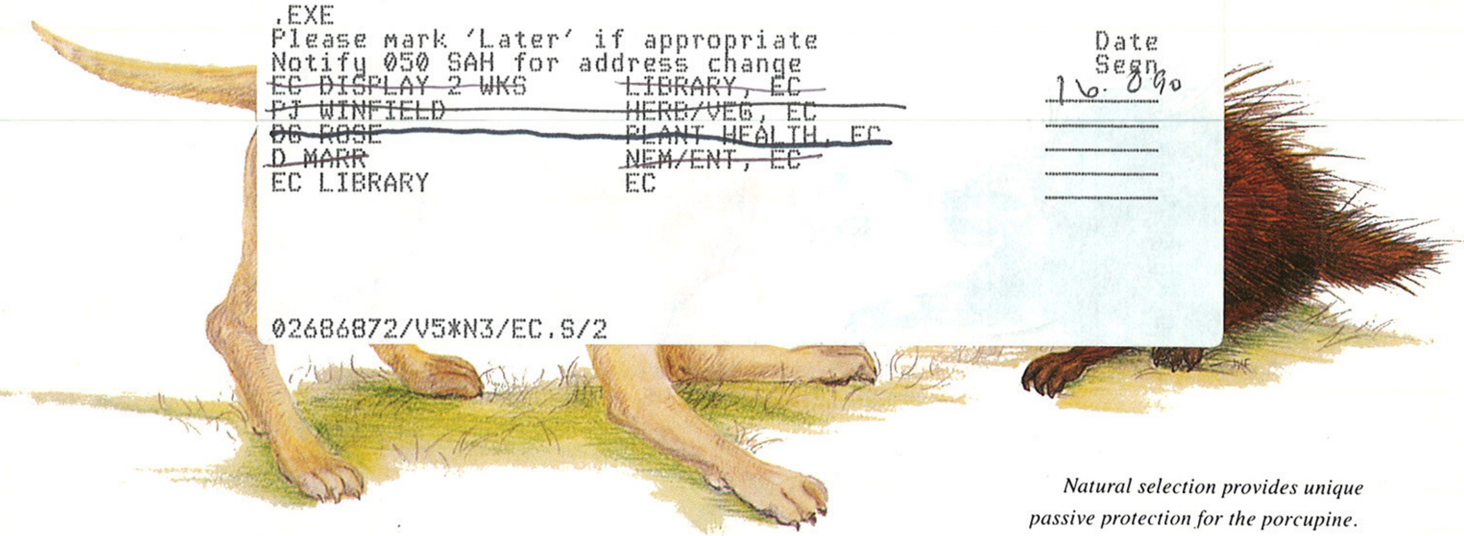

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